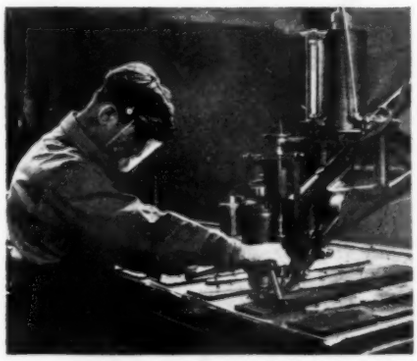
AMERICAN MACHINIST

November 13, 1940



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TO HELP YOU

help America

AMERICA is rushing to arm. *American Machinist,* as it did during the World War, is rushing into print the latest authoritative data on materials and on armament production—written to help you help America. Here are typical recent comments on these special sections.

"Please forward at your earliest convenience 1400 reprint copies each of the following articles: The Working of Magnesium Alloys, The Working of Aluminum Alloys. These will be used in our engineering training program" . . . J. E. Lewis, Engineering Manager, Lockheed Aircraft Corporation.

"In your August 21 issue was a fine story on The Working of Aluminum Alloys. Would it be possible to receive 10 copies of this section for use in our organization?" . . . S. T. Day, Jr., Engineering Dept., Vought-Sikorsky Aircraft.

"Will you please send to J. J. Malespina, Chief Draftsman, 3 copies of The Working of Aluminum Alloys. Your early consideration will be greatly appreciated." . . . P. M. Farmer, Chief Engineer, American District Telegraph Company.

"If you have 5 additional copies of the article on manufacture of the 75-mm shell case, we should be pleased to have you send same to us." . . . Geo. E. Bass, President, Ferracute Machine Company.

"Please send about 10 copies of your folder on how to machine 75-mm shells. We have had a few copies of this but have run out and are in urgent need of more" . . . H. L. Joseph Humphrey, Ex-Cell-O Corp.

"We understand reprints are available of an article on the manufacture of 75-mm shells. We shall appreciate your sending us 4 copies." . . . G. H. Pfefferle, Chief Engineer, Dresser Manufacturing Co.

• • •

10 special sections on the Working of Materials, and 5 on Armament production have already appeared. Another Armament section is in this issue. More are to come in every succeeding issue of *American Machinist*—always first with the latest metal-working data. Watch for them—use them.

WHAT'S IN THIS ISSUE

BRAZEN

Like welding, brazing is one of those originally crude processes that has emerged into respectability. Though long used in production, its future applications, we feel, are bound to show a tremendous increase. The main reason is the controlled-atmosphere furnace, in which parts can be copper brazed without subsequent cleaning. And what a joint! Other factors making for improved quality with lowered cost are wide furnace flexibility and elimination of extensive design changes. On page 903 A. K. Phillippi, Westinghouse manufacturing engineer, outlines a few of the economies.

TWO IN ONE

An effective way of boosting output while cutting costs is to do two operations at once. The trick is to combine them without overwhelming complications. On page 907 Herbert Chase, roving reporter, presents an example of this type whose solution proved to be extremely simple. Where production warrants, the same approach could be used anywhere.

PHILIP M. McKENNA
. . . double carbides for steel

TIPPED FOR TORTURE

The punishment carbide-tipped tools can take is often amazing. So is the work they can do. But like other spectacular improvements over previous practices, they yield disappointment when improperly used. The best material for cutting steel, for instance, might turn out to be an entirely different compound from that giving best results on cast iron. An analysis of the various conditions and ways of meeting them is presented on page 917 by Philip M. McKenna, president of McKenna Metals Company. In it he discusses properties of the recently introduced titanium-tungsten carbide you've heard so much about.

RETURN ENGAGEMENT

You've made H. E. Linsley's acquaintance in these pages before—in the August 7 number, to be exact, when he described Wright Aeronautical's answer to the problem of machine tool lubrication. Mr. Linsley is with us again, on page 908, where he discusses precision thread grinding as used by Wright in engine manufacture. Techniques and practices satisfactory to engine makers should be of considerable interest to all engaged in producing for defense.

TOOLED FOR CHANGES

You know that feeling—just as the new line's running smoothly, Engineering announces several dozen changes in the model. At least one plant will have fewer headaches than usual when that happens. The plant is the diesel engine shop recently opened by International Harvester in Milwaukee. In it everything—well, nearly everything—has been planned for extreme flexibility. In less than eight hours, standard time, the whole works can be changed over from one model to another. The secrets are bared beginning on page 910.

GREAT PROFILE

From California, as you might expect, emerges another seemingly cockeyed idea for working sheet aluminum. After we learned of the Guerin "rubber stamp" blanking process we were ready to believe anything. It's a good thing. For along comes Lockheed with specially built routers for profiling, if you please. Small production, large production, big shapes, little shapes—it's all the same. Details by Louis H. Biehler, on page 926, open up this issue's Armament Section. After breaking into the aircraft industry as a Kinner draftsman, Mr. Biehler joined Lockheed in '34 as a tool designer. Last year he was manager of manufacturing engineering. He's now superintendent of tooling.

LOUIS H. BIEHLER
. . . for profiling: a router

X-RAY FOR ARSENAL

There's nothing amazingly new about using the X-ray for weld inspection. But with Army specifications and testing becoming ever more strict, we thought you'd be interested in seeing what one of the Arsenals is doing with X-rays. Problems include materials handling, radiant-energy protection, and high-speed photo-finishing. How they're dovetailed into a modern X-ray inspection department deep in the heart of a metal-working plant is explained on page 930.

WHILE IN CANADA

Production for defense—and offense—is being pushed to the limit. One important weapon is the Bren machine gun. Tooling used in making these guns is of considerable interest, though much of it is held strictly secret. Passed by the censor, though, is a description of "checks" which have been designed for certain types of thread gages. You'll find it on page 932.

COMING

Fluorescent lighting has received a lot of attention lately, shining as it did so suddenly on the world. Exactly what is fact, what is fiction, concerning industrial applications will be outlined soon. Also scheduled are discussions of balancing rotating machinery and of centerless grinding for small lots. They'll appear soon in AMERICAN MACHINIST.

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with better machine tools

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●

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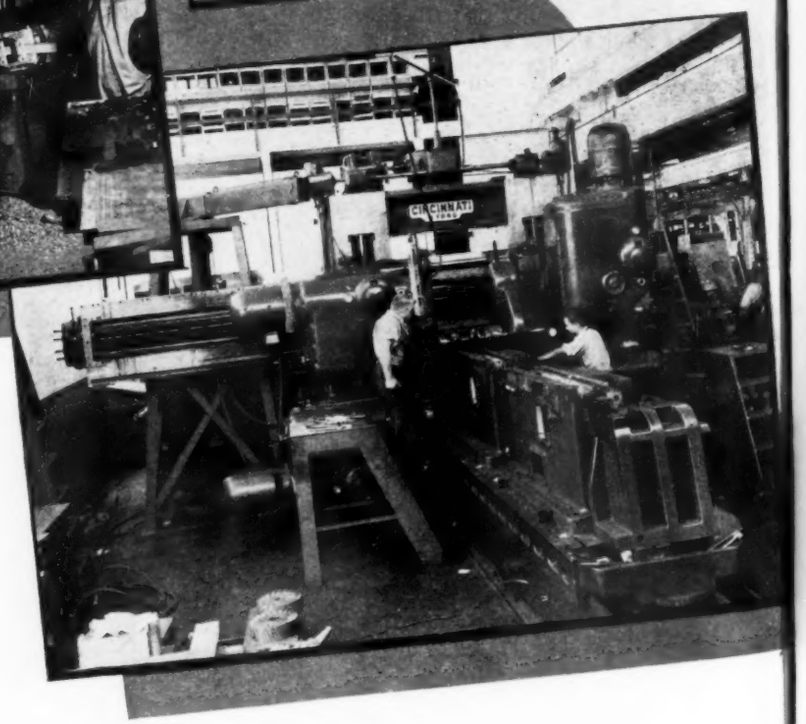

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ESTABLISHED 1877 **AMERICAN MACHINIST** BURNHAM FINNEY, Editor

Copper brazed in a controlled-atmosphere furnace, refrigerator mufflers emerge bright and clean

Saving with brazing

BY A. K. PHILLIPPI, MANUFACTURING ENGINEER, WESTINGHOUSE ELECTRIC & MFG. COMPANY

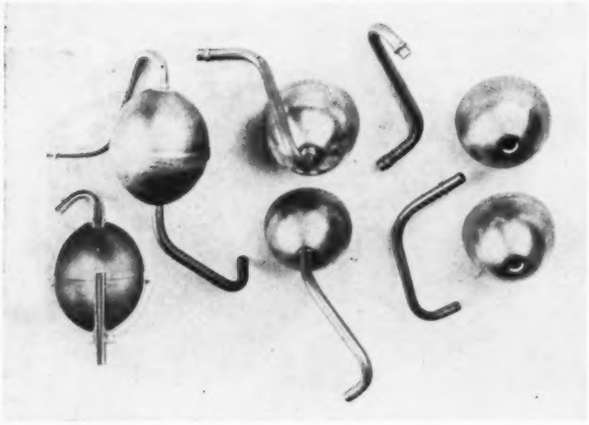
Copper brazing in controlled-atmosphere furnaces proves an effective method of saving on assembling and cleaning costs

COPPER BRAZING of unit assemblies for air conditioning and refrigerator mechanisms in a controlled-atmosphere electric furnace has improved quality, reduced rejects and saved as much as 25 per cent. Though the controlled-atmosphere furnace is not a cure-all for brazing troubles, when properly used it can speed production, simplify inspection and produce a better, neater looking part than obtainable by torch brazing.

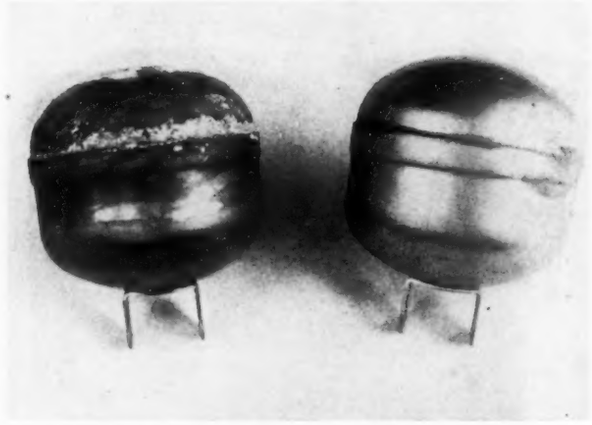
Small metal mufflers for refrigerating units are typical of multipiece assemblies produced by copper brazing. They emerge from a controlled-atmosphere furnace perfectly free from dirt, grease and oxides. Cleanliness is essential for parts that come in contact with refrigerants. The muffler consists of seven parts: an inlet and a discharge tube, top and bottom shell halves, and three brazing rings.

Tubes, of double wrapped steel tubing, are also made by controlled-atmosphere furnace brazing. Rolls of copper-plated strip steel are passed through a set of rollers, forming a tube which is sized in a drawing die and which has its double wall brazed. Close tolerances are held by controlling accurately both steel and plate thickness. Care is taken in designing and fabricating bending fixtures so that the ends are kept perfectly round and are held to proper dimensions. In assembly for brazing into the muffler, a small copper ring is pressed on the tube and the tube pressed to a given depth into the small swaged hole in the top half of the muffler.

The discharge tube has an expanded section approximately $\frac{1}{8}$ in. from the end which is pressed into the swaged hole in the bottom half of the shell, the expanded section holding the copper ring in position adjacent to joint to be brazed. Top and bottom shell halves are made in a punch press. The swaged holes have a wall about $\frac{1}{16}$ in. long. The flared section of the bottom shell is a good snug fit on the top half. After the complete assembly has been made, a large copper ring is placed next to

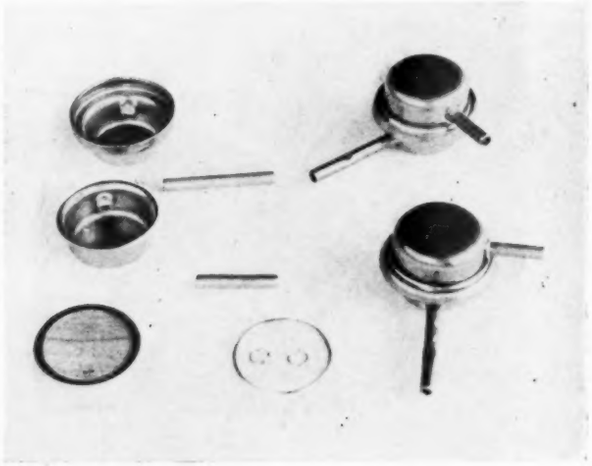


Muffler assembly consists of four major parts and three copper brazing rings. Furnace brazing cut cost 7 per cent and dropped rejects to 0.001 per cent



The float ball on the left was brazed using bronze and an oxy-acetylene torch; that on right was copper brazed in an electric furnace

Steel tube brazed to cold-rolled flanges when sawed in two replaces the unreliable casting at the left



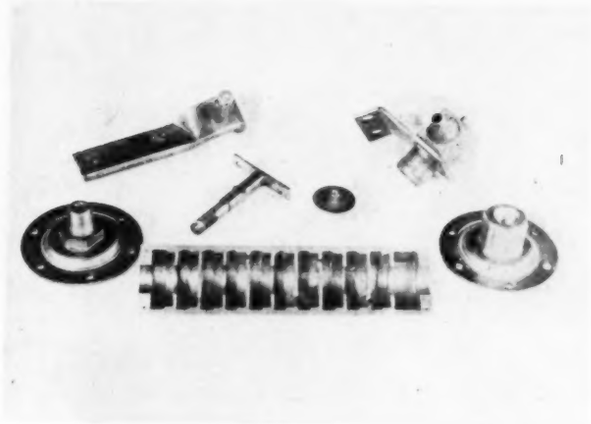
This strainer, especially designed for furnace brazing, replaced one costing twice as much

the joint to furnish the brazing medium. As the entire assembly has a slight slope toward the tube end when on the furnace belt, the rings at the inlet tube joint and the middle muffler joint remain in place. All rings fit snugly. They are formed by winding the proper size wire on a mandrel and then cutting the coil into individual rings. It is important to place the open ends of the rings down, so that when heated they will not open up and fall off. All joints in this assembly are designed to hold themselves together, so that no supporting fixture is needed.

On this part furnace brazing saves 7 per cent over previous methods, and produces a product which is oxide, grease and scale free without any cleaning. Rejects are less than 0.001 per cent. The mufflers were formerly brazed using an acetylene torch with carbon dioxide gas to prevent oxides from forming on the inside.

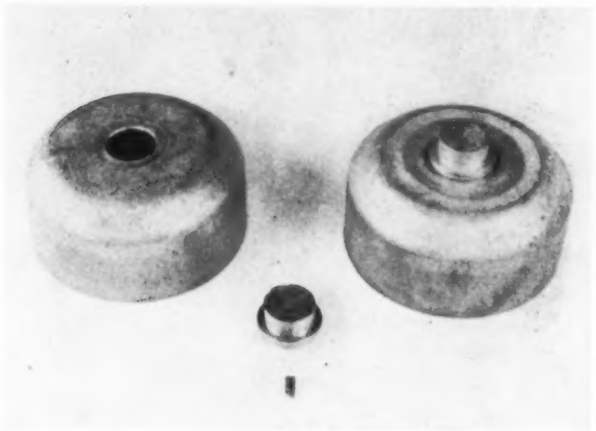
Float balls to regulate refrigerant circulation must be free from oxide, flux and grease. The one on the left in the photograph was brazed using bronze and an acetylene and oxygen torch. It is covered with flux, oxides and brazing material, which must be cleaned off down to base metal at appreciable cost. The bracket at the bottom is spot welded only. In brazing the ball on the right in a controlled-atmosphere furnace, the two halves are placed together, a small piece of No. 22 copper wire is wrapped around the ball just above the joint, and the ends are twisted together. The twist keeps the wire in place until it melts. A small piece of No. 26 copper wire is wrapped around the joint between the bottom shell and the bracket to braze it solidly to the shell. This is in addition to a single spot weld. Cost is reduced about 6 per cent on each assembly, primarily because the balls come out clean and bright, eliminating former cleaning operations.

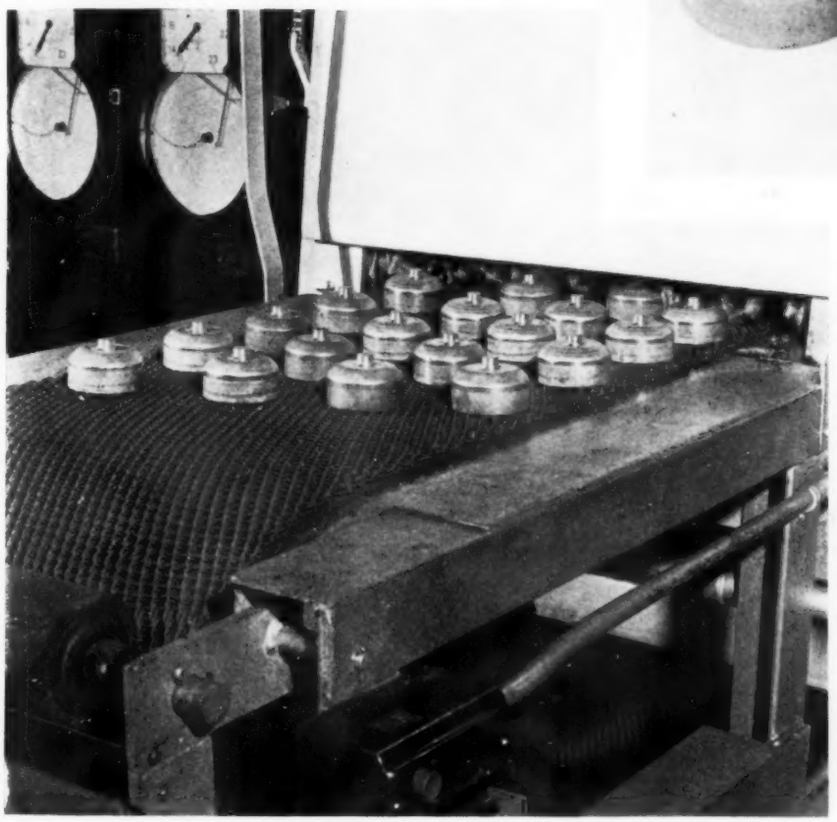
Because of limited production, a discharge flange and tube assembly involving a steel casting was rather expensive to tool up and machine. The mortality on these was quite high since some castings were porous. A modified assembly for furnace brazing makes two complete flanges when the tube is sawed in two. Flanged sections are made from cold-rolled steel bar stock cut to length. A simple drilling and counterboring fixture is all that is necessary. The tubing is a seam-welded steel tube whose outside diameter is qualified on a centerless grinder. In assembling for brazing, the tube is pressed into the flanges, the end of the tube forming one of the steps in the center hole. A copper ring is placed around the tube next to the flange and the assembly passed through the furnace. Saving on this part is about 25 per cent.



Many units designed for other fabrication methods can be more economically made by furnace brazing. These small refrigerator mechanism parts are typical

Even flow of brazing material in this shell assembly simplified balancing. The plug is turned on a screw machine, while the shell is formed in a punch press





Heat-treating effect of the brazing furnace eliminates a separate annealing operation prior to sizing these circulator shell assemblies

A small refrigerant strainer must be absolutely clean and free from oxides. Assembly is simple, as the strainer is placed in the bottom half and the top half placed on top. The two holes are held in proper alignment with short pins in a crimping press. The straight section of the bottom half is crimped over, holding the complete assembly together. The two tubes are pressed into position and two small rings placed over the tubes against the shell. The large ring is then positioned around the crimp and the assembly is ready for the furnace. These assemblies are placed in a rack which tilts the tubes slightly upward to prevent the rings from sliding off. This strainer was never made by any other process, but it replaced a strainer that cost almost twice as much.

In a circulator motor shell a heavy section was necessary on the closed end to give rigid support to the rotor shaft. This shell is blanked and drawn and the hole pieced in the end. The heavy shaft support is turned in a screw machine to fairly close tolerances. It is placed in the hole, resting on the shoulder. A small copper slug is then placed near the joint in such a position that asbestos curtains will not move it when entering the furnace. After the support has been brazed in, the assembly is returned to the press room and is trimmed and sized. Sizing is made possible by annealing while brazing, eliminating the necessity for an individual annealing operation. The even spread of the brazing material, when furnace brazed, helps materially in balancing this shell, in contrast with those which were torch brazed. The assembly is made by unskilled help, which further reduces cost.

Illustrated is a small collection of miscellaneous parts which are furnace brazed. Each not only shows a saving in cost but presents a better appearance. The bottom center piece is a small muffler having baffles spaced inside a steel tube. These baffles are cups with holes pierced in the bottoms. The cups have their sides slightly flared and when pressed into the tubing hug the walls tightly. Dur- this assembly a copper ring is placed against each cup to furnish the brazing medium.

The objects at the extreme right and left of the picture are outlet box covers. The cover itself is standard but has many different fittings brazed into it to meet certain requirements. The part at the upper right shows the possibility of making a product combining a number of individual parts. This unit contains a mounting

bracket, screen, purge valve and capillary tube inlet. All the parts in this picture have shown worthwhile cost reductions.

Products brazed in controlled-atmosphere furnaces will continue to increase. This type of furnace is ideal for brazing parts that must be perfectly free from dirt, grease and oxides. Such products, within limits of weight and size, can be furnace brazed with decided reductions in cost over ordinary methods still in common use.

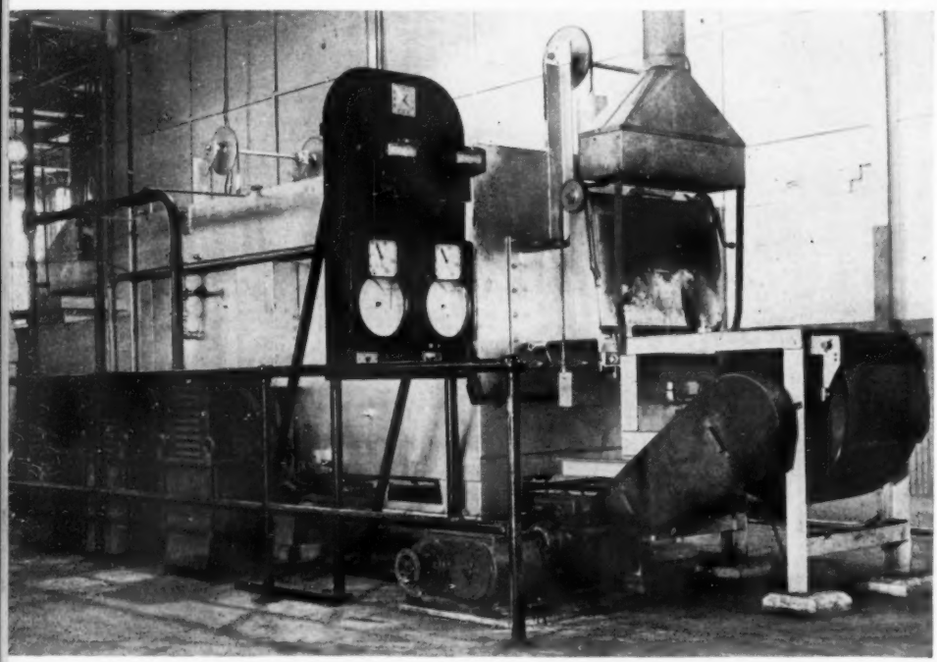
To secure maximum savings the furnace must be properly designed and matched to accommodate the quantity of parts. The furnace used at the Westinghouse East Springfield plant is illustrated. The class of work to be brazed determines the lengths of the heating chamber and cooling chamber, and fixes power required. The cooling chamber must be long enough to bring the temperature of the parts below the point where they will oxidize when exposed to room air. Belt speed is regulated by a variable-speed drive which gives a range of 25 to 125 ft. per hr. Inside the charge and discharge ends asbestos tape curtains help retain the reducing atmosphere when doors are opened to permit work to pass through.

The reducing atmosphere in this case is precombusted coal and water gas. The combustor consists primarily of a set of regulating throttles to control the ratio of gas and air mixture, which can be read on the flow meters in front of the combustion tank. This mixture is forced into the combustion chamber through a nozzle where it is burned. It passes through a cooling chamber to take out any water and then flows into the furnace proper.

Economical operation is based on such things as size, weight, and the number of pieces brazed per hour. This determines the amount of heat the furnace must furnish, the size of the belt, and the belt speed. Most furnaces accommodate a wide range of weights and sizes, having a variable-speed drive so that belt speed may be regulated to suit various conditions.

The mesh type of conveyor for carrying the work through the furnace is used where the pieces are light and can be arranged on it economically. Where heavier pieces are to be brazed it may be necessary to use the roller-hearth type of furnace. This furnace has rollers spaced ten to twelve inches apart. These rollers are made of special steel designed to carry heavy loads at elevated temperatures, and are driven by sprockets and chains located outside the furnace shell. Bearings are of either the ball or roller type, located on the outer shell. These bearings are water cooled to dissipate the heat conducted by the shaft from the roller. In this type of furnace parts are usually loaded on trays, although when the design of the piece is adequate they may be carried through the furnace directly on the rollers.

Because of demonstrated savings, copper brazing in controlled-atmosphere furnaces is here to stay. Although the process has been only recently adopted, drastic cost reductions are so apparent that even small plants without volume enough to warrant purchasing a furnace are sending their work to job shops that can do furnace brazing.



Typical controlled-atmosphere electric furnaces for copper brazing are completely automatic in operation, and can be adjusted to handle a wide variety of parts. Atmosphere is precombusted coal and water gas

What's in a Shell Bore?

BY J. HOMEWOOD

DURING THE LAST World War I had three years of honest-to-goodness headache in machining the insides of both the 18 Pr. and 4.5 H.E. shells for the British government.

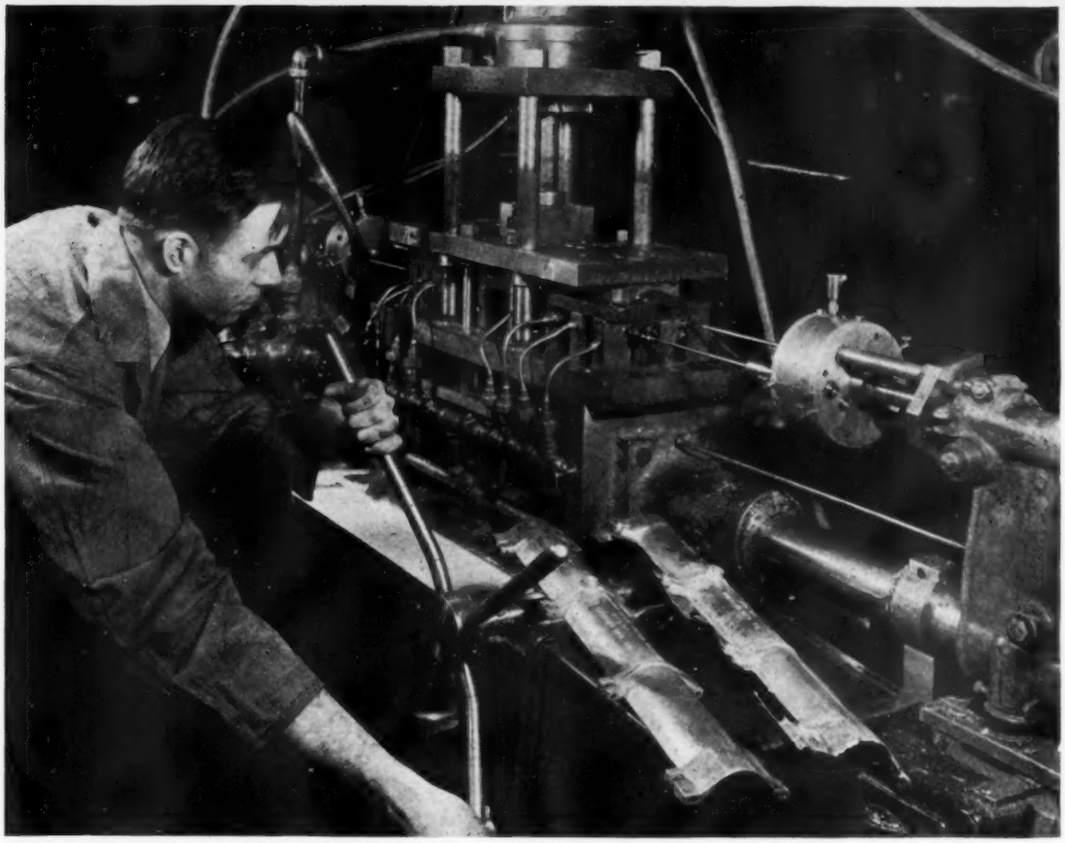
The insides of the shells must be well finished in order to prevent any corrosive action that might cause a premature explosion, but on to the outside of the shell, as Lucien I. Yoemans states (*AM*—Vol. 84, page 526), there are certainly advantages in a coarse feed finish. Personally I have a great antipathy for fine feeds and high polishes unless it be absolutely necessary.

During the early stages of our 18 Pr. experience a cry that went up from the men on the inside-bore machines on account of the seeming unreasonableness on the part of the government authority. This ribbon-bedecked inspector insisted that no tit be left in the bottom of the bore. If he had explained to us the dangers likely to be caused everything would have run smoothly, but the attitude of the men was: "What's a tit more or less."

One of my men, a regular sea-trained Gawd-blimey from the East End, gave vent to his impatience in the following terms: "Tit in the dam bottom of the 'ole; strike me pink, what the bloody 'ell difference does it make any'ow; ain't they goin' to be blown in a thousand bloody pieces?"

Making Dry Ice Colder

SOME OF THOSE who reverse the old shrink fit practice by freezing the piece that goes inside the other, have found a new kink to get even lower temperatures. By mixing acetone with dry ice the temperature can be lowered about 50 F.



Flash is trimmed from an unwieldy die casting with this set-up, eliminating the need for a large press. Hinge pin holes in lugs are also drilled. Production is about 50 pieces an hour

Trimmed and drilled at once

BY HERBERT CHASE

By ingeniously combining some standard units and a few small parts, a troublesome operation can be done with a simpler one

TOOLING for machining die castings need not always involve heavy equipment and elaborate fixtures. A case in point is the set-up devised by Stewart Die Casting Division of Stewart-Warner Corporation for trimming flash and drilling fourteen holes in a cumbersome die casting.

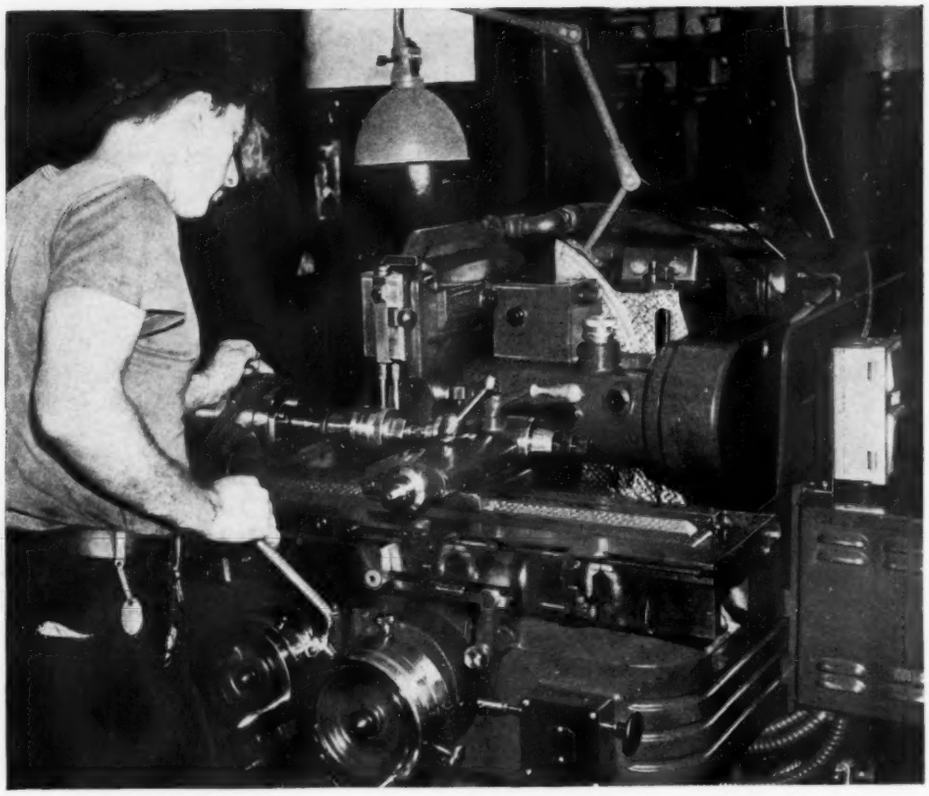
The casting in question is a section of a cable repair sleeve, measuring approximately 4 x 19 in. over all. It has four sets of ears at each side, forming parts of a hinge whose pins fasten the sections together in the complete unit.

In casting this part in zinc alloy, a fin left at the die parting runs around the contour of the piece. A rather large trim die is needed to remove this fin. Instead of doing this trimming in a punch press, which would have tied up a rather large machine, it was decided to use a relatively light hydraulic press for the purpose. In fact, the press was built into the die, since this required little beside a standard hydraulic ram and cylinder and some tie bars.

It is necessary to drill hinge holes in this casting because, if they were to be cored, a bulky and expensive core pulling mechanism would be needed on the casting die. Since the piece can be securely clamped in the trim die, it was decided to fit to the latter a pair of inexpensive drill heads, rather than to make a separate fixture and drill set-up. The drill heads are mounted on tubes arranged to slide in castings bolted to the die supporting plates. They are traversed by racks meshing with pinions turned by a handwheel. Each drill unit has its own motor and is fitted with a geared head having two spindles on the required centers.

All four of these drills must be quite long, since they are traversed about 8 in. They are well supported in four bushings each, as they are only $\frac{3}{16}$ in. in diameter. All four drills are advanced simultaneously, each drill producing either three or four holes (since the lugs are spaced apart) and cutting through $1\frac{1}{2}$ to 2 in. of metal in all. Despite this, 50 pieces an hour are trimmed and drilled complete.

To insure proper lubrication, the set-up includes a small pump to supply oil under pressure through a manifold and pipes to each bushing. This makes, in all, a self-contained machine; but its slight extra cost is warranted because the castings are produced in large quantities, and use of the machine effects a considerable saving in time. It would, in fact, be a slow and rather difficult job to handle in any other way.



External threads are ground in studs, highly stressed cap screws, shafts and other important small parts. In the set-up shown two threaded connections are mounted back-to-back on an arbor, and threads are ground from the solid

Precision thread grinding

BY H. E. LINSLEY, WRIGHT AERONAUTICAL CORPORATION

Accurate ground-thread parts are needed in large quantities for aircraft engines. Wright tool engineers have developed a procedure that gives results

OF THE PARTS on which threads must be ground, studs involve the largest production quantities required for Wright aircraft engines. These are made from chrome-nickel SAE 3140 steel and are hardened to 32–36 Rockwell C. Because of the necessity for producing work of the highest possible accuracy, the blanks first are rough turned and hardened. The two ends, one of which is tapered, and the necked section between them then are ground to size in a centerless grinder. A driving dog is attached to one end, the part placed between centers, and the thread on one end rough ground, leaving approximately 0.008 in. on the pitch diameter for finish grinding.

The driving dog remains attached to the part until the finish grinding operation on the one has been completed. The roughing operation continues until the wheel requires dressing, some fifty pieces are thus roughed out, and then the wheel is dressed and these pieces are finished to size. The tail of the driving dog engages a slotted arm attached to the face plate of the machine and the lead of the thread thus is picked up automatically.

Since one of the threads is tapered, it is obvious that the pitch diameter must be measured at a predetermined distance from the end. This is done with a special indicator gage developed for this operation. V-type gaging rolls are used, a single roll being attached to the stem at the indicator while a double roll is mounted as a lower anvil. In place of the usual commercial practice of using one set of rolls to cover a range of pitches, one set is used for each different pitch. This eliminates errors caused by the difference in helix angle. A second dial indicator is used as an end stop, and both indicators are set at zero from a master stud. As each part is finished it is placed in the gage, turned until the end stop reads zero, and the pitch diameter variation is read on the upper indicator. Limits of as much as $\pm$ 0.00025 in. are allowed, but it is seldom that production parts exceed one-half of this limit. Lead errors are kept at a minimum by using lead screws for each pitch, the maximum error allowed being 0.0005 in. in one inch of length.

Wheel speeds are held constant at 2,500 r.p.m., with an 18-in. diameter

wheel, which is considerably higher than is common practice for this type of grinding. Speed of rotation of the work varies between 20 and 40 r.p.m., according to the diameter. Considerable experimental work was necessary before these speeds could be achieved. Wheels of different grades, grits and bonds were tried. The wheels now used are resinoid bonded, 150 grit, extremely hard, and have a fairly open structure.

Oil is used as a coolant. This oil plays a large part in both the finish obtained and in the output; a recent change of coolant stepped up the number of pieces per wheel dressing from 30 to 50 on the roughing operation. Under present conditions each machine will produce about 60 studs per hour, finish ground on one end.

Many Parts Ground

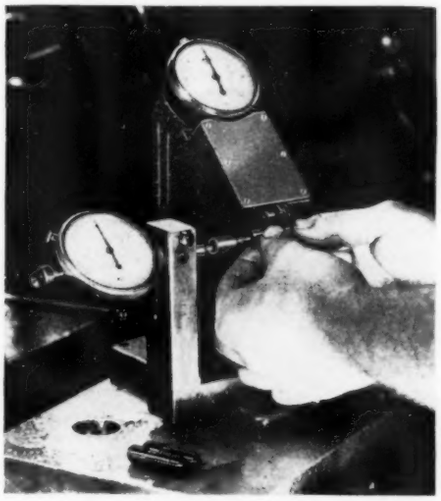
Thread grinding is not confined to stud production. Highly stressed cap screws, threaded shafts and many other important small parts are produced on these same machines. For parts of larger diameter and coarse pitch, such as cylinder barrels, the threads first are rough milled and then are ground on a fully automatic machine in which the wheel is dressed at the end of each grind and the necessary adjustment from rough to finish grinding takes place automatically. This frequent wheel dressing is hard on the diamonds and, for this reason, a somewhat softer wheel is used with a lower grinding speed.

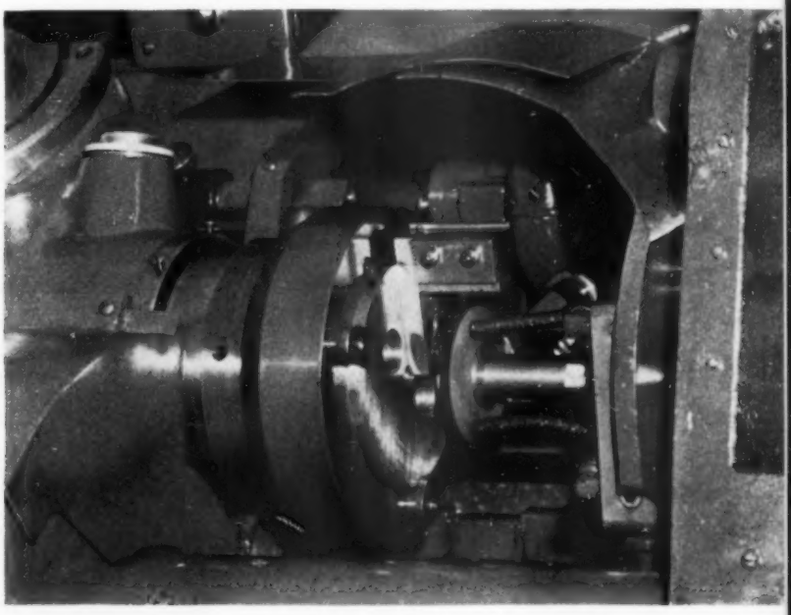
For highly stressed nuts an internal thread grinder is used. This machine has a capacity of from 1 to 8 in. diameter. Most such parts are rough milled before grinding, as this has been found considerably cheaper than grinding from the solid, particularly in the case of larger parts where wheel wear would be excessive. This is not essential, and certain parts are ground direct from the solid without preliminary milling. For example, a 12-pitch thread $1\frac{1}{2}$ in. in diameter and $1\frac{1}{2}$ in. long can be finish ground from the solid in chrome-nickel-molybdenum SAE X4340 steel with a hardness of 290–321 Brinell in a total time of 10 min., using three machines for roughing, semi-finishing and finishing, or 32 min. on one machine, including dressing the wheel after the roughing and semi-finishing operations. The grinding wheel is about $1\frac{1}{4}$-in. diameter and rotates at 12,000 r.p.m. Threads produced in this way are superior in accuracy and finish to those produced by hobbing or tapping, and actually cost no more.

Checking the thread form and lead on internal threads proved a difficult problem until Wright tool engineers developed a simple checking device. This unit consists of a steel disk of the same outside diameter as the part, so that it may be held in the same fixture. Attached to the front face of this disk is a block to which a thin steel blade may be clamped securely. The front face of the blade lies exactly on the center line of the disk. The edge of the blade faces inward and corresponds with the inside diameter of the part.

Simple Thread Gage

When making a new set-up for grinding internal threads, or whenever it is desired to check the thread, this disk is placed in the fixture or chuck and a few threads ground in the edge of the blade. The blade then is removed from the machine and the thread form and lead checked in a comparator. Simple and inexpensive as this is, it has proven highly satisfactory and checks may be made at any time by simply inserting a new blade and placing the device in the holding fixture. The blades are made from 0.015-in. strip steel, although old safety razor blades would serve equally well.





The dial-indicator gage is used for checking the pitch diameter of taper-thread studs at a fixed distance from one end. Allowed limits are ±0.00025 in. on pitch diameter. Small parts on which threads have been finish ground are stacked in special trays having wood bases in which holes are drilled. Parts placed in these holes are kept separated, preventing damage to the threads. Ground internal threads are checked to close limits by using the special fixture shown above. Thread form and lead both are gaged by measuring gashes ground in the edge of a thin steel blade

Different diesels from one line

THE DIESEL ENGINE PARTS production line recently placed in operation by International Harvester Company at its Milwaukee Works is so flexible that parts for several different engines can be made in production quantities on the same lines with only minor changes in equipment. For example, the crankshaft line handles five sizes and one of the cylinder head lines handles two sizes. The new crankcase line produces three sizes for the TD-6 tractor engine which has a 3.875 in. bore and 5.25 in. stroke, the TD-9 tractor engine which has a 4.4 in. bore and a 5.5 in. stroke, and a gasoline adaptation of the latter. The changeover from one model to another can be made in about eight hours, since it consists principally in changing the working heads on the drilling machines, changing some cutting tools and resetting the heads of the boring machines.

The new engine machine shop is located in a saw-tooth roof building equipped with fluorescent lighting which provides an average of 25 foot candles of light throughout the building. Layout has made possible large production in a limited space. No manual lifting or handling is required. Roller conveyors, automatic roll-overs, and elevators all play their part. Materials enter the building at one end; finished parts are taken from the other end by skids and electric trucks. Space was saved by eliminating benches. Instead, each machine has attached to it a tool box or table just large enough to hold necessary gages or tools for that machine and no more. No working platforms are needed as tables were placed at working height by setting large machines in pits. All piping and conduit is in the concrete flooring.

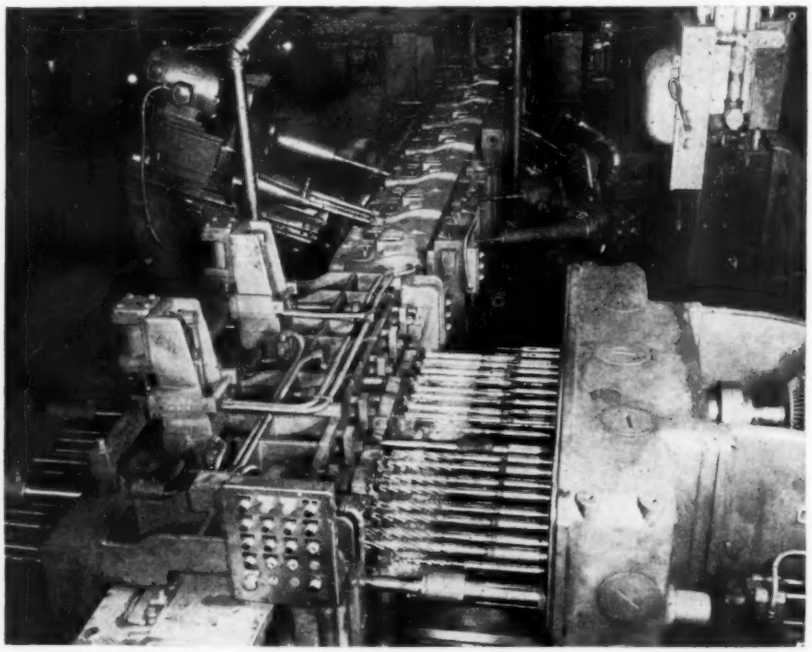
Some tool practices followed are:

All drills are changed after a definite number of pieces have been drilled, regardless of whether or not they are still sharp.

Combination or segmental broaches are not disassembled at the machine. Both broach and holder are removed from the machine and sent to the toolroom. This insures that all sections will be ground equally, and to the same accuracy.

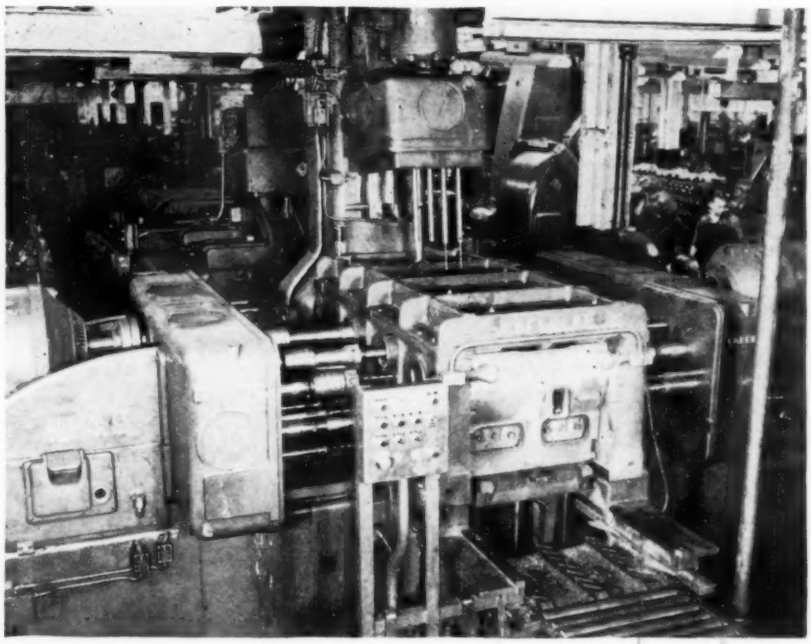
All machines are unit-head type. If at any time a change in engine design occurs, only the cast iron base

Both ends of two sizes of diesel motor crankcases are milled in this Newton duplex hydraulic milling and shaving machine. On the return stroke of the table both ends of the crankcase are "skived" to a straight and smooth finish. A similar machine is used to mill and finish top and bottom surfaces of the crankcases

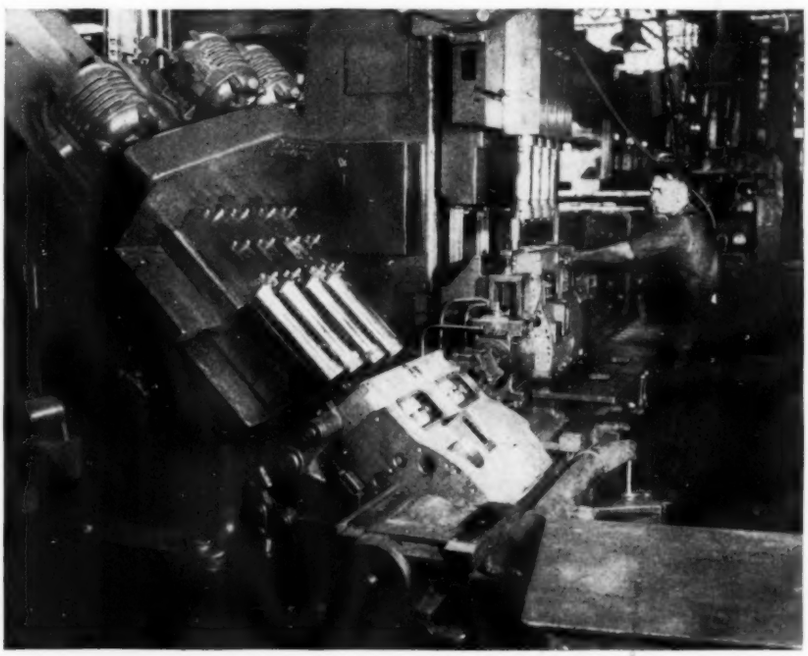


The first of a battery of special Greenlee horizontal machines drills and taps all the holes in the top and bottom of the crankcase as well as drilling and reaming some of the angular holes in the sides of the case. Operation is entirely automatic. Blocks are moved by hydraulically actuated pushers

Production machines in the Milwaukee diesel engine shop just opened by International Harvester are interchangeably tooled for different units



The second Greenlee horizontal machine rough bores the camshaft bore, main bearing seats, and drills all the holes in both ends of the crankcase. Blocks are moved off the roller conveyor to a point where they are taken over by the hydraulically actuated transfer bar, the catches for which can be seen at the machine end. Blocks then are lifted to drilling position



A four-spindle Moline boring machine is used to semi-finish bore the crankcase for the dry liner cylinder sleeve. They are finish bored on the four-spindle Ex-Cell-O precision machine shown in the foreground. Bores are held within 0.0002 in. for parallel and out of round

need be scrapped; the heads can be used again.

Heat-treating operations are placed in or near the line where needed rather than in a separate department.

For the first operation on the crankcase line, the rough casting is clamped on the table of a Newton heavy-duty machine for rough milling the top and bottom. On the return stroke, the same surfaces are finished by "skiving" without appreciable loss of time. One long tungsten carbide blade is mounted at an angle to the vertical on the end of a hydraulic ram which moves into position to make this finish cut. The finishes achieved are excellent as gasket surfaces. The two ends of the crankcase are machined and "skived" on another Newton milling machine.

Various locating and other holes are drilled, cylinder bores are roughed out and bearing seats and notches are straddle milled on standard tools.

By gravity feed conveyor the crankcase then is delivered to a group of three special Greenlee automatic transfer machines, operated from one master pushbutton control board. These machines drill and tap the rest of the holes in the crankcase automatically, except for the camshaft and crankshaft bores.

The first of the three machines has fourteen stations for drilling and tapping top and bottom holes and some angular holes in the crankcase. Holes in the ends of the block are drilled and tapped, oil pump hole bored, and oil gallery hole drilled through the full length of the block in the second machine which has fifteen stations. The latter operation is accomplished in three steps: one-quarter through from each side at station two, one-half through from one side at station three, finished from other side at station four. An eight-station machine for the holes in the sides of the crankcase completes the drilling and tapping operations.

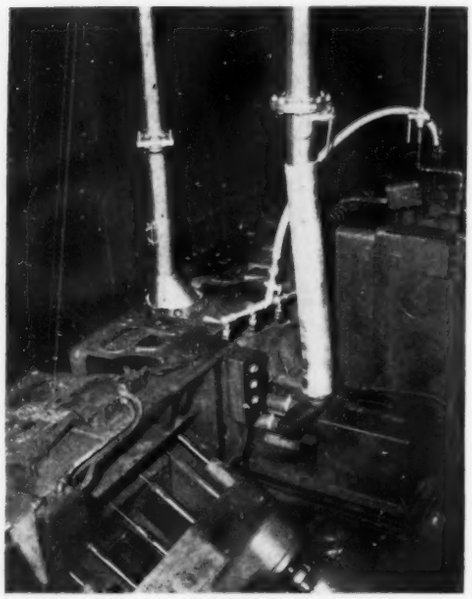
The crankcases are moved along from station to station by hydraulically operated pusher bars, the progress of the work being controlled by a series of limit switches which are interlocked to provide proper sequence of operations. Interspersed between the three drilling and tapping machines are automatic turnaround and chip unloading devices which require no attention. Automatic washing machines timed in conjunction with the drilling machines are placed in the drilling and tapping lines.

At various stations on the three machines automatic suction devices remove chips from the crankcase,

carry the chips to the roof of the building, and remove them from the roof by gravity conveyor to one common unloading spot outside the building. This prolongs the life of the machines, eliminates untidiness in handling chips, and produces some savings in costs.

Camshaft, crankshaft and oil pump bores are rough and finish machined simultaneously in a Greenlee machine, thus maintaining their relative positions accurately for precision results. Cylinder bores are rough-bored on a Moline machine and finish-bored on an angular-type Ex-Cell-O precision boring machine. Spindles on each are driven individually so that the boring heads need only be respaced to suit another size of block.

All machines in the crankcase line

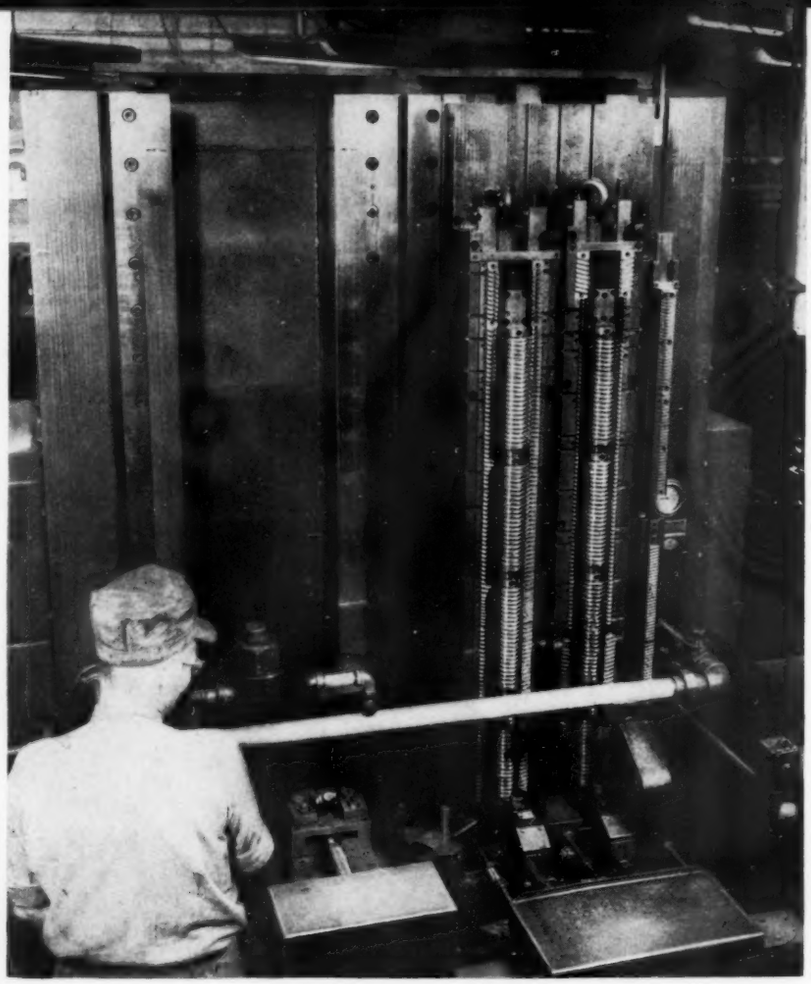


A chip exhaust system, developed by the Milwaukee Works, is installed at the end of the first Greenlee machine. All drilling chips are extracted from the crankcase by vacuum and are delivered into a receptacle on the roof

are automatic-cycle, pushbutton-control models with adequate safety devices. Throughout the line, no manual lifting, clamping, or trucking is performed. At no time is it necessary for a crankcase to be removed from a conveyor, even for inspection.

On the crankshaft line all shafts are handled on a 500-ft. endless overhead conveyor, which makes a complete circuit of the machines on the line. The conveyor cradles carry six crankshafts each. No trucking is done.

The crankshafts are Tocco-hardened and the latest type of Norton grinding equipment is used in grinding line and pin bearings. These machines are designed to maintain tolerances to within 0.0003 in. A Tinius Olsen crankshaft balancing machine is used to obtain both static and dynamic balance of crankshaft.



Sides of the connecting rods at both ends are straddle broached in this Oilgear 40-ton double slide machine. Connecting rod caps are straddle broached on one side and the back face and half-round diameter of connecting rod and connecting rod caps are broached on the other side. All clamping is automatic

An automatic Snyder machine drills, counterbores, reams and taps the flange holes in the crankshaft. On the other end the machine drills and reams two diametrically opposite holes in the stud end. This is a four-position machine with a lateral automatic index from front to rear, with automatic return to starting position when all operations have been completed.

All main and pin bearings are polished on a Schraner hydraulic polishing machine which is so flexible that it handles five different crankshafts. The inspector's test on this machine is made by the use of a flat piece of steel similar to a Johansson block, upon which a slight trace of Prussian blue is placed. After contact with the block, the crankshaft must show a trace of blue throughout the entire length of the bearing being checked. Periodic checks are made with a profilometer, smoothness being required because of the excessive loads imposed upon the diesel engines.

The first operation on the connecting-rod line is that of broaching the two sides of the crankpin, two sides of the wristpin, the half-holes, the caps, contact face and two mortise joints which hold the cap and rod together, and the back side of the rod, which is machined so that it may clear through the cylinder bores. The equipment used is a vertical twin-ram, 40-ton Oilgear surface broaching machine with two fixtures, having a shuttle motion in and out in sequence with two rams. All pieces are clamped automatically.

The crank bore is finish-ground on a Heald Guagematic machine which eliminates the possibility of a bell-mouthed bore. Distance between the two mortised joints on the cap contact faces is held to a total tolerance of 0.0005 in. The oil hole between the wristpin and crank bore is drilled on a Leland-Gifford "woodpecker" type drill press. Wristpin hole is diamond

bored on a two-spindle Ex-Cell-O diamond-boring machine.

Balancing pads are provided at both the wristpin and crankpin ends of the rod, and the rod is balanced to within 0.2 oz. in. on a rise-and-fall Snyder automatic balancing machine. The connecting rods are thus held in balance from the beginning of production, an important factor in reducing future service problems.

All connecting rods are carefully inspected in the forge shop for grain flow, trim marks and scratches, and each rod is magnafluxed to guard against future fatigue failures.

Cylinder heads are made of alloy iron with a high chrome content and are carefully checked for cracks, flaws, or blow holes, both before and during the process of machining.

Tops and bottoms are rough and finish-milled on a special Ingersoll drum-type machine. All holes, regardless of angularity or position, are drilled in multiple equipment of unit-head type which is flexible enough to take care of any future designs. An interesting machine in the cylinder head line is a special Oilgear broaching machine which presses in all valve guides simultaneously and then broaches and burnishes them on the inside for the valve stem. The broaches fall through into a container beneath the machine.

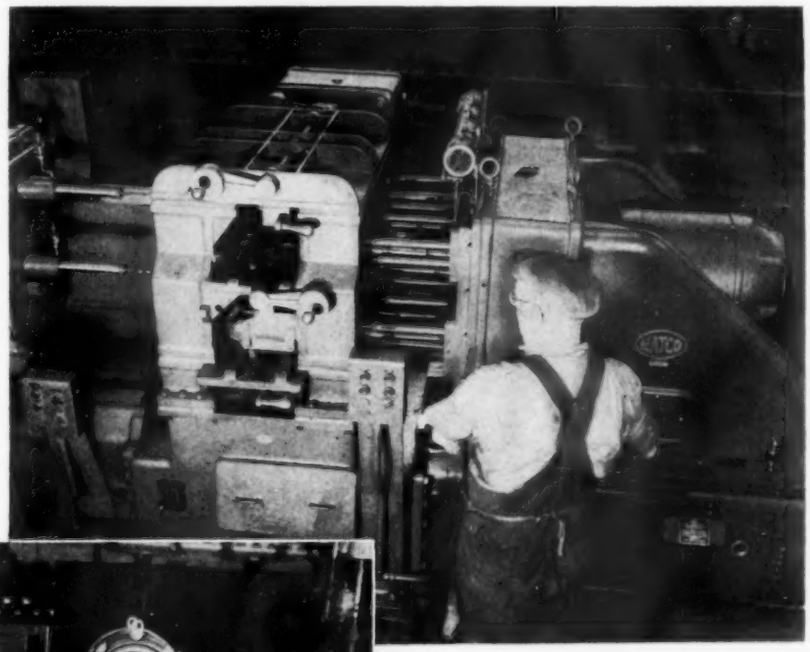
All pistons are turned on automatic lathes. The wristpin hole is bored on an Ex-Cell-O precision boring machine. All pistons are handled on conveyors, with a return conveyor underneath for empty trays.

The outside diameter of the Lynite piston is not ground, but is diamond turned on a special Sundstrand automatic lathe. The finish and smoothness are claimed to be at least equal, if not superior, to the usual ground finishes. Cast-iron pistons are finished in centerless grinding machines.

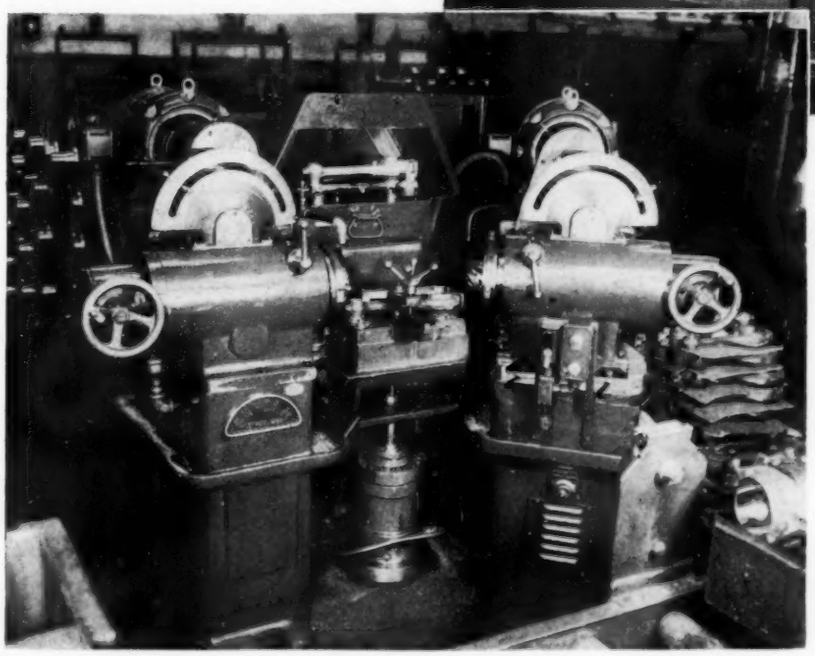
Cylinder sleeves used are hard, dry liners. They are rough bored on a vertical eight-spindle W. F. & John Barnes machine. Outside diameters are turned on automatic Fay lathes and they then are delivered to a gas furnace, which is installed adjacent to and as a part of the line, for heat-treatment. These sleeves are hardened to 45 to 55 Rockwell C.

After heat-treatment, the sleeves are reamed on a battery of Baker hydraulic drills with special equipment developed by Barber-Colman, the cutters of which have blades with inserted tantalum-carbide tips.

Special short gravity-feed conveyors are placed between groups of operations so that no trucking is necessary. Sleeves run on these conveyors on their own periphery. The piston line and sleeve line converge at a common point where pistons, pins, and sleeves are fitted together.



Two sizes of motor cylinder heads can be drilled in this Natco horizontal three-way machine. A TD-9 cylinder head is machined in the lower magazine while the TD-6 head is drilled in the upper



Connecting rods are balanced on a Snyder machine. Pads at each end of the rod can be milled off to the close limits required. Total variation of 0.2 oz. in weight of the four connecting rods in the diesel motor is maximum permitted

Among the miscellaneous parts manufactured in the new shop are oil pumps, oil pump covers, water pumps, drive pulleys, starting crank nuts and other small machine parts, as well as repair parts. Such equipment as No. 5-A Potter & Johnsons, Heald facing machines, and Monarch, Fay and Gisholt lathes are used to machine a number of small parts. A six-spindle, rotary-type, Lees-Bradner vertical machine is used for cutting timing gears. It is so built that if one spindle requires repairs, the other five may still be kept in operation.

How to use dressing tools

BY H. J. WILLS, ENGINEER, THE CARBORUNDUM COMPANY

Dressing grinding wheels at regular intervals following a standard procedure is more economical than dressing when the wheel seems to be loaded

APPARENT VARIATION in the performance of grinding wheels of exactly the same specification frequently is due to variations in dressing practice. For example, if a wheel is dressed with a dull diamond it will give the effect of a loaded wheel, and will act several degrees harder in grade than the specifications show.

To get the greatest output with uniform results in production work, wheels should be uniformly dressed at regular intervals, regardless of the apparent need. Any saving in time from infrequent dressing is more than off-set by reduced production and shortened wheel life.

For any job, the wheel should always be dressed in a manner determined by tests as the best procedure. For instance, the frequency of dressing, rate of traverse and depth of penetration should always be the same for a given job. Only carefully recorded tests will show the best method to be used.

For precision grinding and the production of fine surfaces, wheels should be balanced before and after truing. New wheels may be somewhat out of round when mounted. When balanced in this condition they will run out of round, but after truing this false balance is destroyed and the wheel must be rebalanced. Also, wheels that are in good balance at grinding speed may become out of balance at higher or lower speeds. A wheel that has been trued wet must be dried before rebalancing, since the nature of the out-of-balance is sure to be affected by the moisture in the pores of the wheel.

Traverse lines on the work often are caused by the dragging edge of a wheel. If the wheel is not grinding to a shoulder, dragging can be prevented by rounding off the edges with a dressing tool or hand stone. If necessary, finish the rounding with aluminum oxide paper. This also will prevent the tool from chipping the edge.

Scratches on the work often are caused by abrasive grains which have been loosened, but not removed from the wheel. When the wheel face comes in contact with the work, these grains roll between the work and the wheel. Loose grains can be removed by scrubbing the face and sides of the wheel with a stiff bristle brush and clean water after each dressing.

Faulty dressing or truing may result from performing these operations at a point on the machine away from the grinding position. This may be due to the fact that the ways of the machine are worn more at one point than the other, and is a frequent cause of dragging edges. Dressing with the tool exactly on the axis line of the wheel will help.

It usually is a mistake to dull the

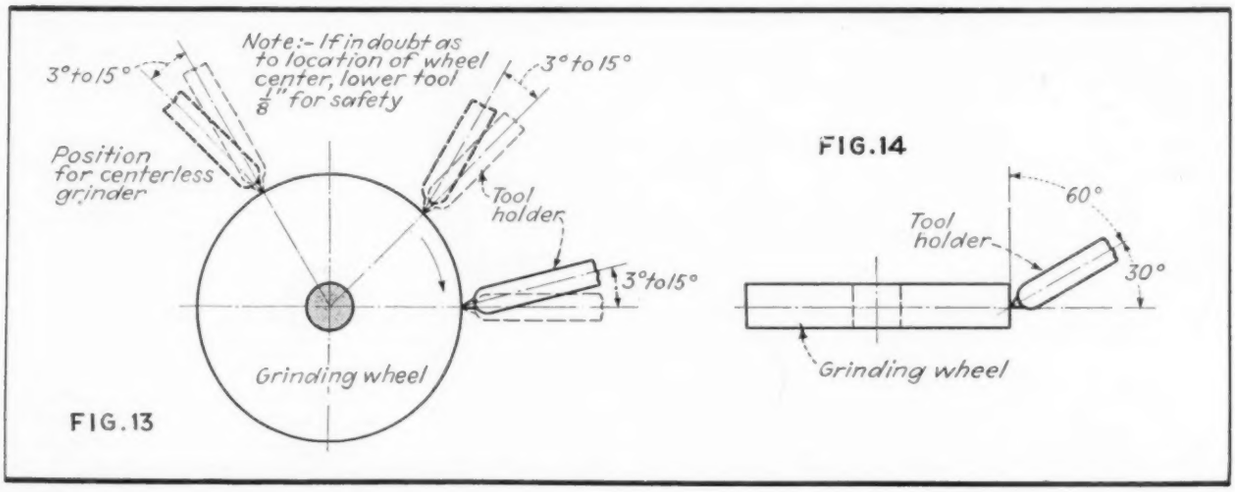


Fig. 13—For best results, the diamond dressing tool must be set up at an angle with the wheel face as shown. Never set the stone above the radial line of the wheel, orchattering and gouging are to be expected. Fig. 14—To avoid diamond marks on the wheel, set the tool at 60 deg. with the face of the wheel in the horizontal plane

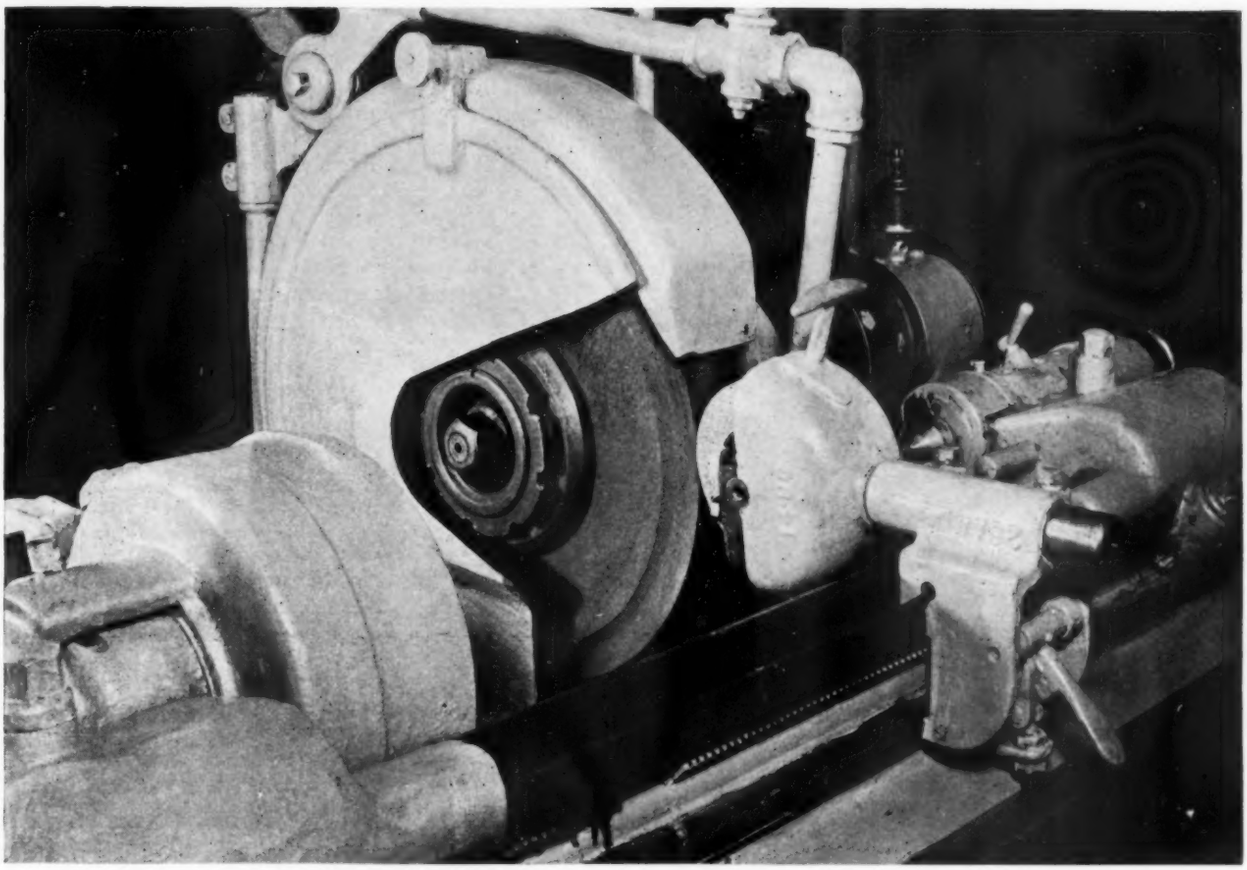


Fig. 16—Abrasive wheel dressers usually are set at 5 to 7 deg. angle with the axis of the grinding wheel. Dressing wheel grit and grade should be such as will hold a straight cutting face across the grinding wheel face

Fig. 15—This photograph indicates the correct position of diamond dresser and coolant nozzle for proper wheel dressing

face of a wheel for the final passes. The burnishing action which results gives a pleasing finish which may be covering a poorly generated surface. The best surfaces are built up by grinding with a succession of wheels of diminishing grit size, all of which are sharp enough actually to cut.

If a wheel is used for wet grinding, dress it with coolant, and vice versa. If a wet grinding wheel is dressed dry, the pores will retain some of the coolant and the cuttings will adhere to the face, to become loose and cause scratches. A grinding wheel that is dressed wet will become gummy when grinding dry.

Unless the coolants used in grinding and in dressing are clean, the particles of foreign matter will roll between the wheel and work, scratch the work and score the wheel face, thus necessitating more frequent dressing. The number of pieces per dressing can be increased materially if an efficient filter is installed in the coolant system.

If dressing were merely for the purpose of removing material from the wheel face, a Huntington "star" dresser would do the work best. For a wheel to be sharp enough for precision grinding, the abrasive crystals must be completely fractured and project above the bond. This can be accomplished only with a sharp diamond.

A dull diamond will crush some of the grains down into the bond, and partially break others. These will break away in operation, come loose and roll between the work and wheel.

A wheel dulled by a dull diamond will act harder than its actual grade. This dulling often is so gradual that it is not immediately apparent. Production suffers, and when the wheel is finally dressed with a sharp diamond it acts much softer. To get consistent production and finish it is essential to sharpen the wheel frequently with a sharp diamond.

To prevent chattering of the diamond tool and to eliminate the possibility of gouging the wheel face and damaging the stone, the tool must be at an angle with the wheel face in the vertical plane, as shown in Fig. 13. This is done by first setting the diamond holder on the radial line of the wheel, with its side parallel to the side of the wheel. The rear end of the tool then is raised to make an angle between the tool axis and radial line of the wheel from 2 to 15 deg.

Keep Close to Radius

If there is any doubt as to the exact radial line of the wheel, drop the point of the tool slightly, not more than $\frac{1}{4}$ in. below the supposed radial line. This is to prevent any chance of the point being above the axial line, which would cause it to gouge the wheel, and probably break the

stone. By rotating the stone in its holder at frequent intervals, this setting maintains a sharp point on the diamond. However, the point may cause diamond marks on the wheel.

To avoid such marks, the holder should be set an an angle of 30 deg. to the tool axis in the horizontal plane, that is 60 deg. to the face of of the wheel, as shown in Fig. 14. This setting wears a sharp, broad edge on the diamond, which will dress the wheel openly, without threads. Turn the diamond frequently to maintain sharp edges.

For ordinary grinding, it is satisfactory to contact the stone at the highest part of the wheel, supposing the wheel to have been worn convex or tapered. For high finish grinding, however, the best practice is to bring the diamond nearly into contact with the wheel, start the traverse and feed in 0.001 in. at the end of each pass until contact is made. Never spot a diamond on the face of a fine grit wheel.

Unless the stone is set in a special tool whose settings are designed to be ground away as the diamond wears, it is poor practice to grind into the setting. This is because ordinary tools are designed to expose the greatest possible amount of stone. Grinding into the setting will weaken the hold on the stone, and damage or complete loss is apt to result.

The diamond dressing tool is a precision tool of considerable delicacy. If good grinding is to be done, and excessive diamond cost avoided, it is necessary to observe certain precautions.

Unless a stone of the correct size is used, diamond marks may appear on the wheel. There will be too rapid diamond wear and possibly a broken diamond, if the stone is too small. Choosing a stone of the right size is an important factor in keeping diamond costs down.

Support Dresser Rigidly

Make sure that the stone is properly set, otherwise it may come loose or break; or cause chatter or gouge marks on the wheel. If a stone is cracked, burned or shows flat spots, discard it. Otherwise, you may get chatter marks and a dulled wheel face. Both diamond and wheel costs will be too high.

Chatter and diamond marks, gouging and diamond breakage may result if the mounting tool is not rigidly supported with minimum overhang and in the proper location and angle. Sharp angled stones (splinters) should not be used for high finish grinding as they cause marks which can be removed from the wheel only by the expenditure of excessive time for smoothing the wheel face. Unless plenty of coolant is used when dressing, or in dry grinding ample time allowed for cooling, the stone may burn, break or come loose in the mounting. Shocks are apt to break the stone. Diamond cuts should not exceed 0.001 in. in depth if marks are to be avoided and economical diamond costs achieved.

Abrasive wheel dressers are applied to the grinding wheel at an angle from the vertical. The greater the angle the more open the resulting grinding wheel face. The usual angle is from 5 to 7 deg. Since deeper infeeds and coarser dressing wheels give more grinding wheel faces, it is evident that by changing angles, infeeds and grits a variety of dressing effects can be secured with abrasive wheel dressers. Thus, with a given dressing wheel it is possible to secure finer and consequently slower grinding action by lightening the cuts and decreasing the angle.

Traversing the dresser without infeed causes glazing, regardless of

traverse speed. In traversing, do not allow the dresser wheel to pass off the grinding wheel. When that happens the dresser loses speed and when it again contacts the grinding wheel, at lower speed, the grinding wheel will be gouged. Also, when the dresser is allowed to run off the face of the grinding wheel, even partly, the contact area is decreased, the penetration increases due to the greater unit pressure, and the edges of both wheels may be rounded or even broken. However, if traverse lines are present, they may be eliminated by allowing the dressing wheel to pass off the grinding wheel.

Dressing wheel grit and grade should be such as will hold a straight cutting face across the entire grinding wheel face. If an abrasive wheel dresser gives an irregular dressing action, or fails to true a wheel, the cause probably is that the dressing wheel itself needs truing. Its errors may be dressed into the grinding wheel. The less the angle between the wheels, the more the trouble is exaggerated. To true the dressing wheel take a light cut against the grinding wheel with an angle of 10 to 15 deg.

Incidentally, the abrasive wheel dressing tool depends for its accuracy largely upon the accuracy of its bearings. A slight bearing imperfection will be multiplied on the grinding wheel as chatter and out-of-roundness.

Although it is desirable to use coolants with the abrasive wheel dresser, general practice is to dress dry. When this is the case, both wheels should be thoroughly flushed with clean water after using the dresser.

Double Dressers

Hard-bond grinding wheels, those with wide faces, and some silicon carbide wheels tend to chip the dressing wheel edges and to taper them. This can be overcome by equipping the dresser with two wheels instead of one. Each wheel is $\frac{1}{32}$ in. less than one-half the width of the single wheel. They are separated with a standard blotter. This doubles the number of cutting edges and smoothing faces. The two cutting edges at the center are applied to the grinding wheel at the point of greatest pressure, where formerly there was only a smooth surface. Such two-wheel tools can be used at slower traverse speeds and lighter feeds, which gives a better face to the grinding wheel for finish cuts. The angle is the same. However, with double dressing wheels it is necessary to use plenty of water when dressing.

To dress wheels for semi-roughing (63 to 1,000 micro inches) the abrasive dressing tool should be traversed at about 40 in. per min. with a feed of 0.002 to 0.003 in. per pass.

For wheels to produce "commercial" surfaces (8 to 63 micro inches) use 40 in. per min. traverse for a few passes at 0.002 to 0.003 in. feed per pass. Then reduce to 20 in. per min. traverse with 0.001 in. feed for several passes. Too many passes may smooth the wheels too much.

For wheels that are to produce "medium fine" surfaces (4 to 8 micro inches) use the procedure for "commercial" surfaces, followed with the same feed at 10 in. per min. traverse. The final pass is made without infeed of the dresser.

For fine surfaces (1 to 4 micro inches) use the method given for medium fine surfaces, but use a water coolant for all stages of dressing, and set the tool at a smaller angle. Never let more than one-third of the dressing wheel face pass off the grinding wheel.

The third and final article of this series by Mr. Wills will appear in an early number.

Carbides for cutting steel

BY PHILIP M. McKENNA, PRESIDENT, McKENNA METALS COMPANY

Ever since tungsten-carbide tools proved their worth on cast iron, metallurgists have sought a similar material for use in machining hard steels

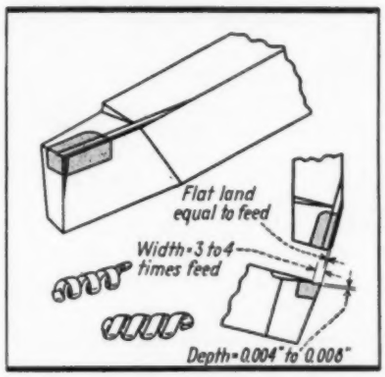


Fig. 1—When turning most steels above 0.35 carbon and harder than 250 Brinell, this tool will produce short, coiled chips

PROPERTIES required in a cemented-carbide for resisting "cratering" from tough, hot, swiftly moving steel chips and for resisting breakage from interrupted cuts, are entirely different from the hardness and heat conductivity needed for machining abrasive materials of lower tensile strength. The search for a tool metal for cutting steel at high speeds led to the development a few years ago of a crystalline intermetallic compound, a double carbide of titanium and tungsten, corresponding to the chemical formula $WTiC_2$. This compound made it possible to produce a metal which effects economies for steel-cutting that are similar to those effected by tungsten carbide when used for cutting cast iron and brass. These two carbide tool materials should not be confused. They have different fields of usefulness, and are used in tools of differing shapes.

Produced in grades containing varying proportions of the compound $WTiC_2$, these compounds are harder than the hardest tool steel (67 Rockwell C), and have strength in cross rupture which approaches that of high-speed steel. Thermal conductivity is about the same as for tool steel or two and a half times as great as that for tungsten carbide. Compressive strength of these compounds is high, up to 690,000 lb. per sq.in. They are not so rigid as tungsten carbide compositions, having a Young's modulus of about 58,000,000 lb. per sq.in. compared to 80,000,000 for tungsten carbide. This point is of practical significance when taking intermittent cuts on rough steel forgings or castings.

Turning Tools for Steel Parts

For turning bars or smooth forgings in engine lathes or turret lathes, right-hand tools, such as the one shown in Fig. 1, are preferable. Such tools should have chip breaking grooves, which are effective at depths of only 0.004 to 0.008 in. The slight interruption to the flow of chips caused by these grooves curls the chips into short coils which break off into lengths easily removed from the lathe pan for most steels above 0.35 car-

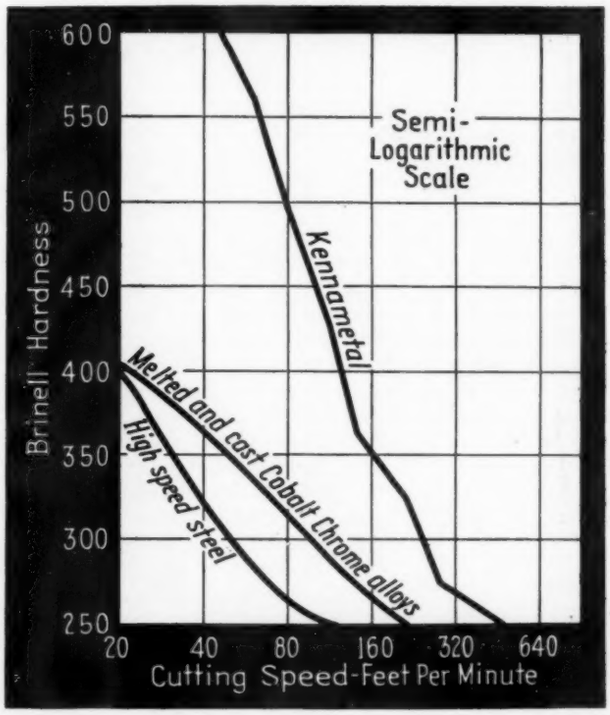
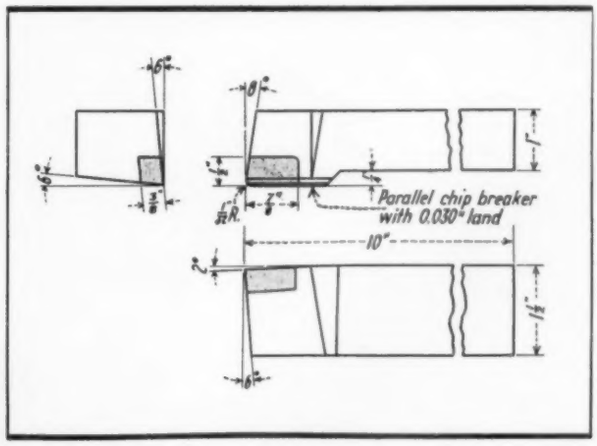


Fig. 2—Comparative chart of machining speeds with single-point tools on commercial steels, such as SAE 1045, SAE 3140 and SAE 4320, of varying degrees of hardness

Fig. 3—Employed for turning against a 90 deg. shoulder, this tipped tool has a zero side cutting edge angle. It will not last as long as a tool having a 15 deg. lead angle



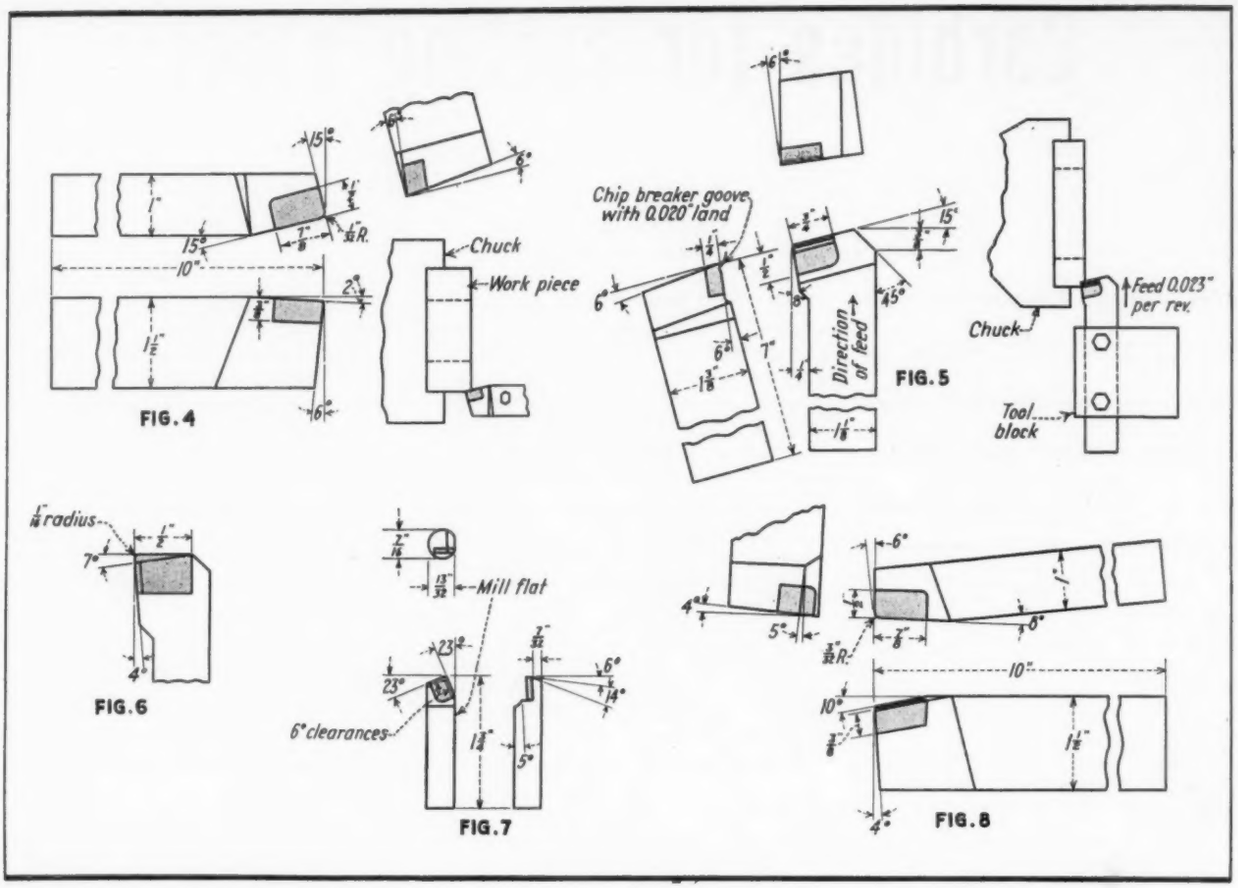


Fig. 4—This carbide-tipped tool is suitable for many facing cuts in steel. A chip-breaker groove is not necessary for most facing operations. Fig. 5—Used in turret lathes for facing gear blanks, this tool has a chip breaker groove along the cutting edge. Fig. 6—This facing tool, having a chip-breaker groove at a 7 deg. angle with the cutting edge, can be used when facing to a 90 deg. shoulder. Fig. 7—Tools of this design set at 75 deg. from the axis of the boring bar are suitable for boring long holes in steel tubes. Fig. 8—Recommended for planing and shaping operations, even with "jump" cuts, this carbide-tipped tool has negative side and back rake

bon and above 250 Brinell in hardness. A flat land, or in some cases a land having a two-degree negative rake, made equal in width to the feed per revolution is provided along the cutting edge.

Speed of cutting varies with the hardness of the work-piece. In Fig. 2 is plotted on semi-logarithmic scale the recommended speeds for cutting steels in various degrees of hardness. This chart also shows comparable speeds possible with other tool materials. Steel-cutting carbide tools do not operate efficiently at the speeds used for machining steels with tungsten-steel tools. To cut cleanly and smoothly with minimum of built-up edge, they must be run at two to six times the speed of high-speed steel tools on the same work.

For work where the chip is tougher, and not hard enough to break with the chip breaker design shown in Fig. 1, a shelf-type chip breaker may be employed. In this design, the groove is extended to the cutting edge as a "shelf" which is at a large angle with the side cutting edge. The terrace up which the chip must run deflects it sharply against the unturned shoulder of the bar, snapping it off in short fragments.

For turning against a 90-deg. shoulder, a tool such as that shown in Fig. 3 may be employed. This tool has a zero lead, or side cutting edge angle and has a parallel chip breaker groove with a land on the cutting edge having a width equal to the feed employed when using the tool. It should be noted that where it is not necessary to form a 90 deg. shoulder in turning, the tool shown in Fig. 1, having a lead angle of 15 deg., gives greater tool life.

Facing Cuts in Steel

For facing cuts on steel parts, the tool shown in Fig. 4 may be used to advantage. It is similar in design to the tool shown in Fig. 1, except that it is of the opposite hand. The shorter cuts commonly required in facing present less difficulty in disposing of chips. The tendency of chips to break due to changing speed as the cut proceeds from the periphery to the center of the work piece also helps dispose of chips on facing cuts. For this reason, chip breakers often are not necessary on short facing cuts. The lower speed near the center of the work reduces the efficiency of cutting. A variable speed drive on the lathe which permits a speeding up toward the center of the work will provide greater cutting efficiency.

Another common form of facing tool, designed for use in Warner & Swasey or Gisholt turret lathes for facing gear blanks is shown in Fig. 5. When facing to a 90-deg. shoulder with a radius, a tool as shown in Fig. 6 may be used. This tool has a chip breaker at an angle of 7 deg. with the cutting edge. The radius on the tool will be satisfactory when ground to

a templet, with clearance all around under the cutting edge.

For boring large diameter work, such as locomotive tires and large rolls in Bullard, King, Niles and similar mills, tools similar to that shown in Fig. 4 may be used. On large work these tools do not require chip breakers. For boring long holes in steel tubes, with round tools held in a boring bar, tools set at 15 deg. from a right angle to the bar (75 deg. from the axis of the bar) may be used. They should be shaped somewhat like the tool shown in Fig. 7.

Carbide-Tipped Boring Tools

Precision boring tools for such machines as those made by Heald and Ex-Cell-O are used with steel-cutting carbides, both for plain bores and for bores having interruptions, such as oil holes or slots, in the smaller sizes. Solid rounds of carbide often are used instead of tipped tools. They require careful grinding for clearance, often employing compound clearance angles, or preferably circular clearance. High negative back rakes, often as much as 40 deg. negative, may be employed in combination with positive side rakes of as much as 25 deg., going over interruptions with high tool life. These tools should be ground on special machines arranged to generate the clearances and rakes automatically on diamond wheels or laps.

Since the introduction of high-strength steel cutting carbides, many shaper tools tipped with this material have been used on steel castings and die blocks too hard to be shaped with high-speed steel tools. There is little to gain from using a carbide tool for shaping or planing soft steel under 302 Brinell, but in cases where a die block or casting must be shaped in the hard condition, these tipped shaper tools are invaluable. They also are recommended for machining cast iron in which hard spots are encountered, since these spots cause rapid dulling of high-speed steel tools.

Interrupted cuts are no obstacle when the tool is ground with double negative rakes as shown in Fig. 8, which is recommended for all shaper and planer work. Light cuts and feeds at the higher speeds available on planers or shapers, usually 80 to 100 ft. per min., are preferable. The combination of negative back rake with negative side rake angles used on these tools would not be practical if the tool material did not have non-galling characteristics. Steel castings and other parts having interruptions which cause breakage of the more brittle tungsten-carbide tool materials are often machined in shapers and planers with these tipped tools to advantage, especially where steel tools wear and lose size rapidly.

Carbide-Tipped Form Tools

As a simple example of successful form tools tipped with steel cutting carbides, Fig. 9 shows a tool with an internal radius for forming small bearing races of SAE 52000 steel. Also tools having internal radii are supplied for machining Nitroloy steel airplane gear blanks.

The usual dovetailed tangent cutting form tool has been used successfully with a steel-cutting carbide blank brazed along the top. The form is ground into this blank. Since back rake is not used when cutting steel with this material, computations of forms are simplified, although the hardness of the metal makes diamond wheels necessary for profile-grinding the form. Form tools of carbide should not be used where the steel to be form turned is soft enough to cut readily with the more easily ground tungsten high-speed steel or cobalt-chrome alloy tools, or where automatic screw machines are incapable of the higher speed required.

Cut-Off Tools

Certain types of cutting-off jobs on steel are done satisfactorily with tools tipped with these carbide materials. These include those where a blade wider than $\frac{1}{4}$ in. may be employed, and those which do not cut off to a dead center, as in tubing or forgings with a central hole. These limitations are due to the tendency to weaving on narrow blades, and the low peripheral speed as the tool approaches the center of the work. Shell forgings 4 to 6 in. in diameter with walls 1 to $1\frac{1}{2}$ in. thick are cut off with a tipped tool such as that shown in Fig. 10. In this particular operation it has been found more practical to leave about $\frac{1}{32}$ in. wall, to be broken off by a hammer blow when the work is removed.

The hard steel-cutting carbides may never be ground with wheels customarily used for grinding steel tools, as they are invariably cracked or surface checked on ordinary wheels. Manufacturers of grinding wheels have produced special loose-bond silicon carbide grinding wheels which are suitable for free-hand grinding, constant motion of the tool being essential. Another essential is the use of a *star* dresser every few minutes, since these wheels grind only by constant exposure of freshly fractured abrasive grains. Wear of silicon carbide wheels is rapid, and despite the greater initial expense, diamond impregnated Bakelite-bond wheels are cheaper in the long run, whether the tools are ground free-hand or in a fixture.

Economy in grinding carbide tools requires that as little grinding of the steel shank as possible be done with the special wheels; surplus steel shank to form the clearance should be milled or ground away on wheels better adapted to removing steel cheaply. It is advisable to spare the diamond

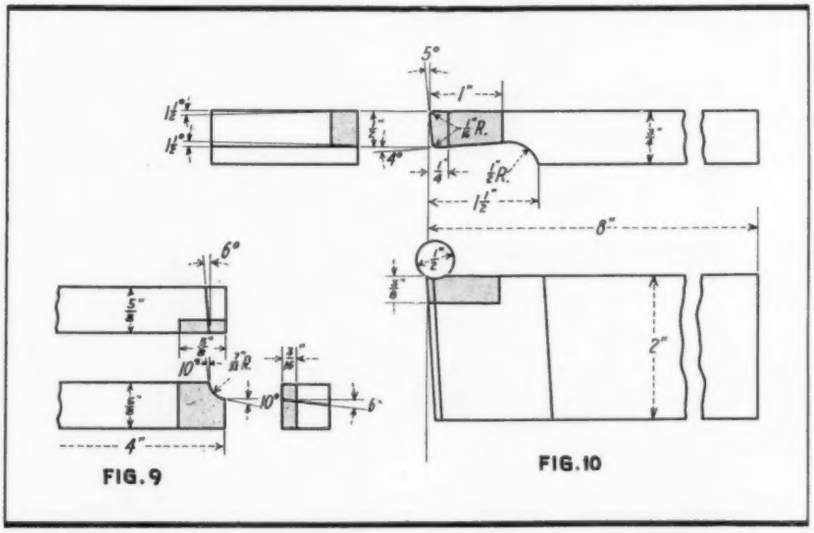
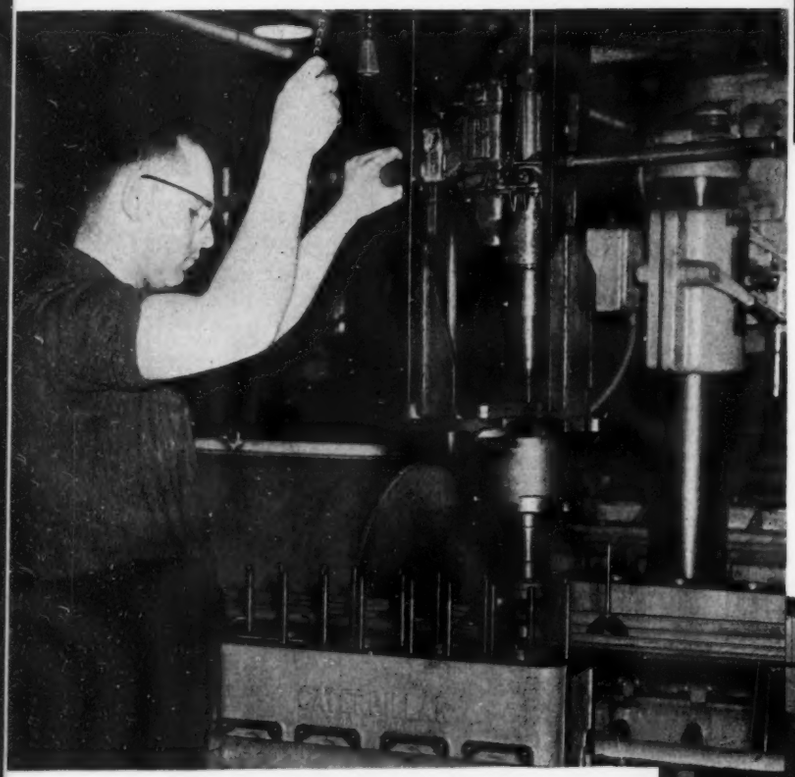


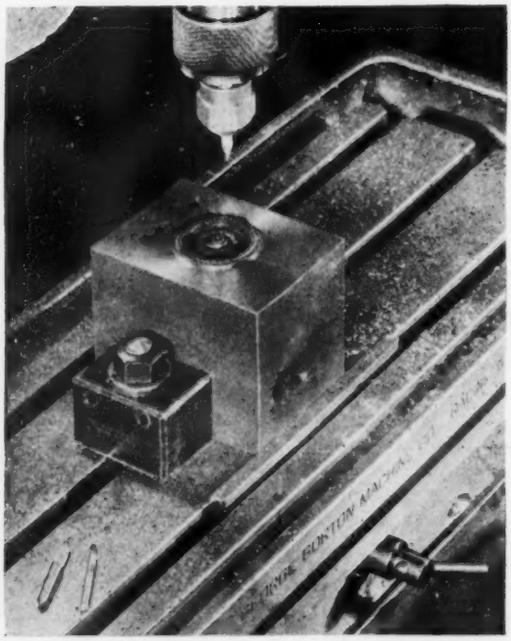
FIG. 9 FIG. 10

Fig. 9—Carbide-tipped form tools are satisfactory for forming parts made from SAE 52000 and Nitroloy steels. They must be ground on the profile with diamond wheels. Fig. 10—This carbide-tipped tool was developed to cut off steel shell forgings 4 to 6 in. in diameter with up to $1\frac{1}{2}$ in. wall

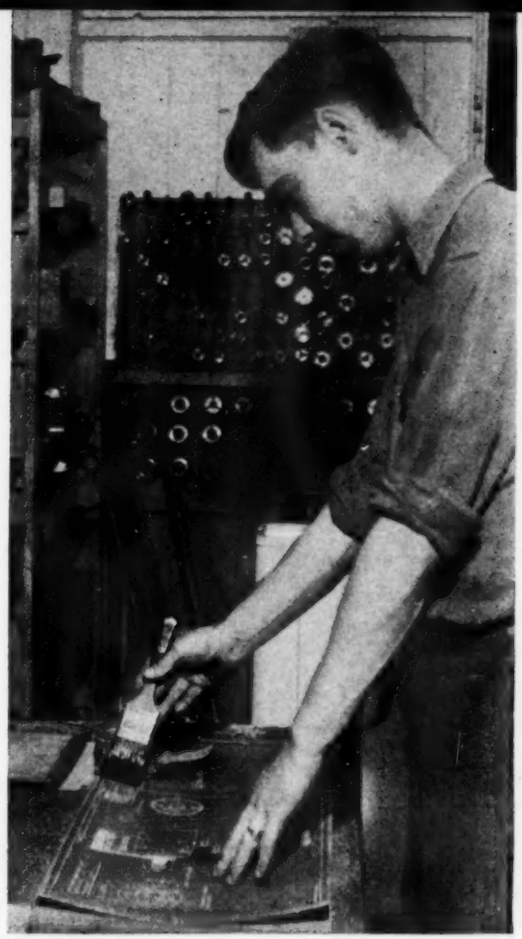
Shop shots



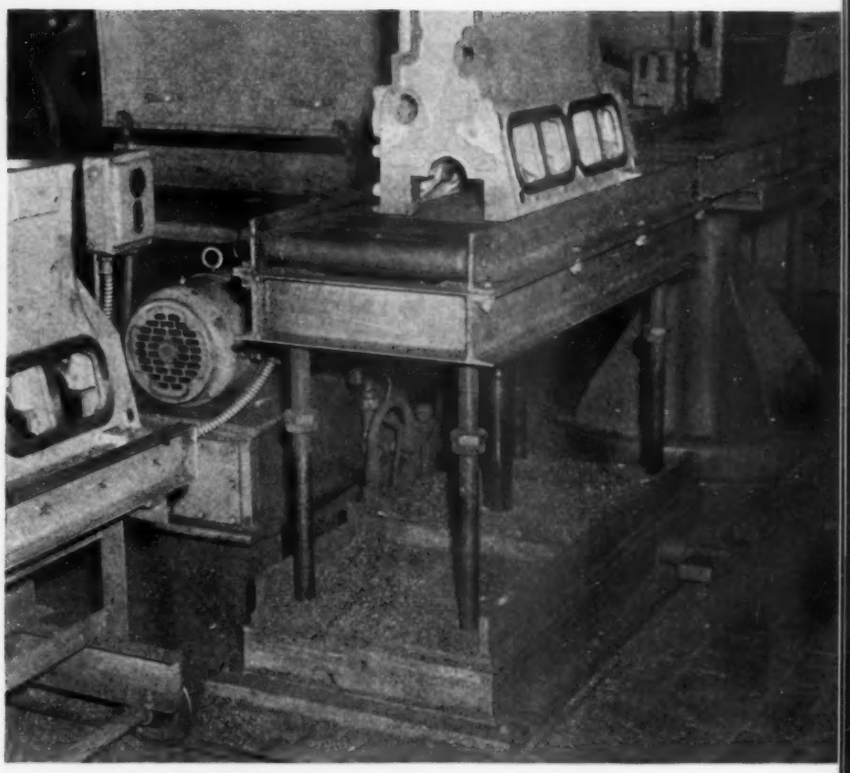
Time is saved in final reaming of cylinder liner seats, left, by this air-driven device suspended above the engine block conveyor line. A welded frame supports the air motor for driving the cutter bar. On the same shaft is the screw which feeds the reamer. Slots inside the frame permit the motor to feed down. Studs in the block serve as guides and hold-downs for the machine, which removes about 0.015 in. in the final operation. Below, inspection gage is suspended by a spring-balance at the left. Caterpillar Tractor Company



Fastening small parts to a milling or duplicating machine table is made easy with blocks fitted with T-slot hold-down bolts. Through each block pass two diagonal setscrews, which bite into the work and prevent it from creeping up



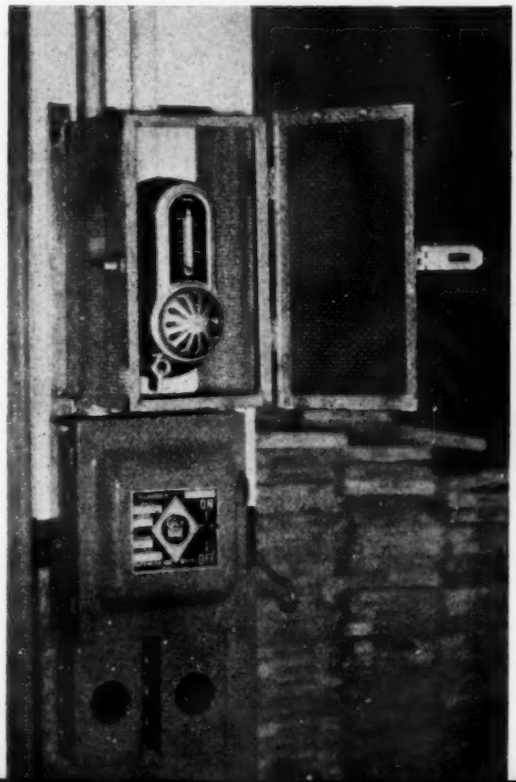
Blueprint wear is reduced greatly by backing shop prints with chip board, which can be obtained from most printers. One side of the board is covered with library paste, after which the blueprint is pressed on, using a photographer's roller squeegee to smooth it. After drying, both sides are given a thorough coating of white shellac. Dumore Company

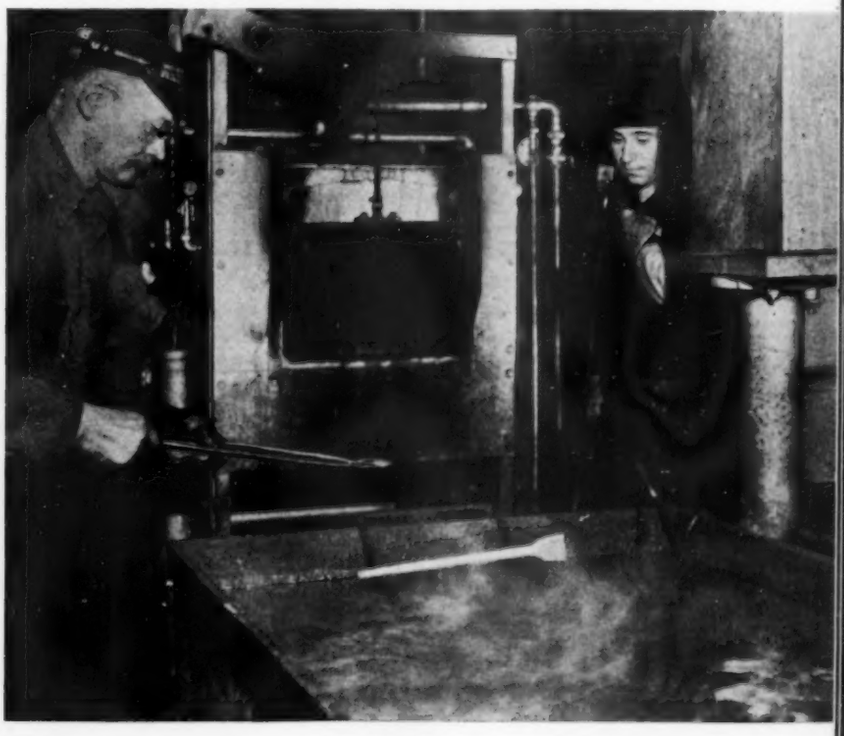


Lifting engine blocks from one level to another is easier with this self-contained hydraulic unit. Motor and constant-speed hydraulic pump are mounted on top of the welded reservoir. Oil flow to the cylinder which lifts this conveyor section is controlled by the pedal in the lower right-hand corner. Round bars at the four corners of the device serve as guides. Caterpillar Tractor Company

To insure proper quench without distortion of the small ends, chisels made of 0.75 carbon steel are rolled down a ramp into the brine tank, thus immersing all portions almost simultaneously. Ramp sides are made of two long steel rods bent to give a total height of about 12 in. Independent Pneumatic Tool Company

Protection of thermostats from accidental blows and other damage is given effectively by a wire mesh cage. Large mesh should be used to permit free air circulation for best thermostat operation. George Gorton Machine Company



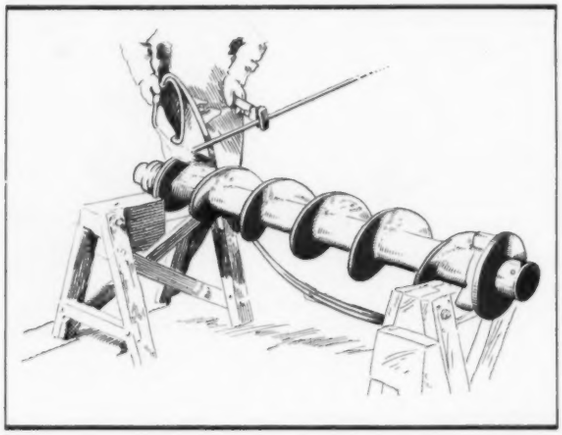


IDEAS FROM PRACTICAL MEN

Reclaiming Locomotive-Stoker Screws

By ARTHUR HAVENS

Stoker screws are seldom too badly worn to be reclaimed. Sometimes the flight of the screw, originally over $\frac{1}{2}$ in. thick, is worn to a feather edge. In reclaiming Duplex elevator screws, the usual procedure is to turn off the flight of the screw until it



Duplex stoker elevator screws worn to a feather edge can be rebuilt by flame cutting the flight $1\frac{1}{4}$ in. undersize, tack welding a $\frac{5}{8}$-in. steel strip along the flight, and welding the faces of the flight to the required thickness

is $1\frac{1}{4}$ in. under its original size. This allows the operator to fashion a bar of $\frac{5}{8}$ in. square steel along the outside edge of the flight, thus returning the flight to its original size. By keeping this square bar tight against the flight it will be unnecessary to machine the periphery of the screw when the welding is completed.

The $\frac{5}{8}$ in. square bar stock is cut into pieces about 6 ft. long—this to facilitate handling. One end of the bar is tack welded to the extreme end of the flight at the bottom of the screw and flush with the bottom of the flight. The screw is then laid horizontally on horses and blocked so that it will not roll and the bar stock is heated with a welding torch so that it will bend easily to the shape of the flight. The operator will notice that it requires a slight twist in the bar stock to keep it at right angles to the screw. It is best to tack weld the bar stock to the flight at about 10 in. intervals.

After the bar is tack welded to the flight, enough material is added to build the screw up to required thickness. The welder can use a fairly large welding head and can use as many as two 5/16-in. rods at one time.

The Duplex conveyor screw presents a slight problem due to its length and varying diametrical sizes. It is very difficult to turn this screw down to size for the application of the steel bar to the edge of the flight. The easiest way to gain this end is to secure the screw in a lathe as if it were going to be machined, then fasten a cutting torch to the tool post and as someone turns the chuck by hand, manipulate the hand feed on the carriage so that the torch will follow the flight of the screw. A neat and suitable surface will result, and the bar stock can be tack welded to the conveyor screw. Since the conveyor screw is longer than the elevator screw, it is difficult to handle while welding. A splendid idea on this is to cut one head from a second-hand locomotive main reservoir and sink it in the floor, leaving the open end flush with the floor. The long conveyor screw can then be held over this open end by a crane or hoist, and as the welding progresses the screw can be lowered into the reservoir.

Due to the varied sizes on the Standard stoker elevator and conveyor screws, it is not possible to prepare the screws for a square strip by turning. In this case the flight is carefully calipered and a piece of round stock sufficient in size to return the screw

Short stoker screws can be set vertically on the floor for welding the flight to the required thickness. Conveyor screws can be lowered into a pit by crane as welding proceeds

to its required size is tack welded to the edge of the flight. However, if the wear is less than ¼ in. it is built up with welding rod. The part of the conveyor subjected to the most wear are those flights in the crusher zone; therefore, these will be found to be in much worse condition than the balance of the conveyor. Sometimes this is the only part worn enough to require rebuilding, and for this reason, hard surfacing is recommended. The teeth on the crusher itself come in for their share of wear. They should be rebuilt with wear-resisting material.

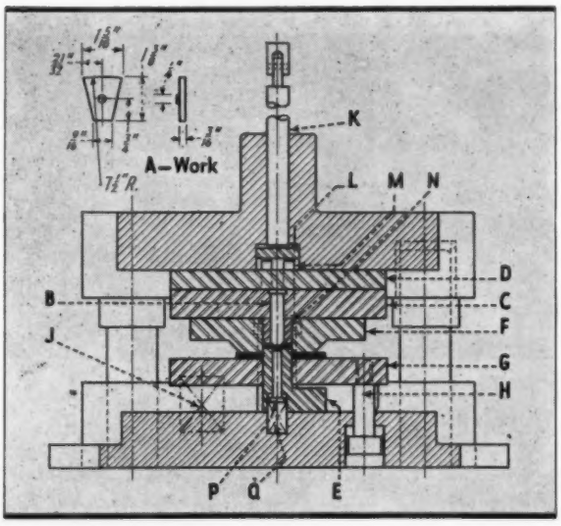
Press Tools for Embossing and Blanking

By WILLIAM B. GREENER

The press tools illustrated were designed for embossing and blanking a large quantity of parts from scrap stock, such as the one at *A*.

The tools are mounted in a standard die set and consist of the embossing punch *B* inserted in the plate *C* and backed up by plate *D;* the blanking punch *E* mounted on the die shoe; the blanking die *F* attached to the punch holder; the stripper *G* guided by the shoulder screws *H* and operated by springs at *J;* the knockout *K* operated by plate *L;* the pins *M* attached to the shedder *N;* a plunger *P;* and the spring *Q*.

In operation, the scrap stock is placed on the blank-



This die was designed to emboss the part just after the ram begins its descent, and blank the part as the ram nears the end of its stroke

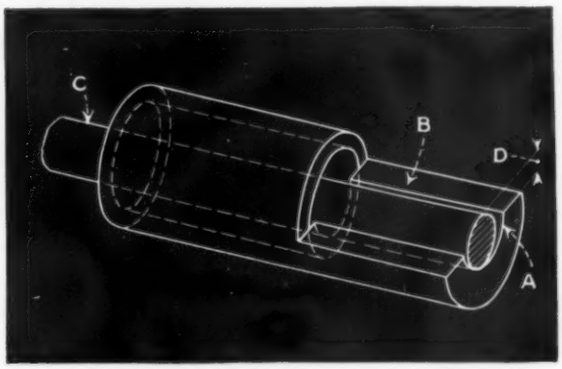
ing punch and as the ram descends the part is embossed. As the ram continues its descent and nears the bottom of its stroke, the part is blanked by the punch as the blanking die passes over it. On the upward stroke of the ram the stripper is forced upward by the springs and strips the waste stock from the blanking punch. The knockout is operated by the knockout bar on the press through pins on the shedder and pushes the part out of the blanking die.

Measuring the Radius of a Cut-Away Bore

By WILLIAM S. ROWELL

Two methods for measuring cut-away bores, such as shown at *A* in the drawing, were suggested by Mr. George Belbes (*AM*—Vol. 84, page 472). In both methods, it is suggested that the spindle be turned until the faces *B* of the cutaway bore are brought into horizontal alignment by means of a vernier or indicator. The writer believes that there is a simpler way of doing the job.

In the first method suggested, a rod *C* is inserted in the bore, and an indicator or vernier reading taken at the top of the rod. The difference in height *D* between the faces of the half bore in the top of the



The radii of half bores can be measured in a variety of ways: the author suggests that a straight edge and height gage can be used as conveniently as the methods described in the text

rod, subtracted from the diameter of the rod will give the radius of the cut-away bore.

In the second method, after the faces *B* are brought into horizontal alignment, Mr. Belbes suggests finding the lowest point of the bore with the aid of an indicator, and subtract the reading from that of the faces *B*.

Both methods suggested by Mr. Belbes, assumes that the surfaces *B* are in the plane of the centerline of the bore. Mr. Belbes' suggestions were offered as improvements on a method described by H. Moore, (*AM*—Vol. 83, page 919). However, Mr. Moore stated that the part cut away was on or *below* the centerline. Mr. Moore's method is convenient and requires little time; but because of expensive apparatus, it can only be justified by making a considerable number of such bores.

One need not follow Mr. Belbes' suggestions in determining the radius of half bores. If the surfaces *B* are in the plane of the centerline of the bore, the radius of the cut-away section can be found in a number of ways. One would be to place a straight edge on the surfaces *B* and measure the greatest rise, or drop, of the bore from it, thus securing the radius. If the plane of surface *B* does not coincide with that of the bore centerline, the amount and direction of

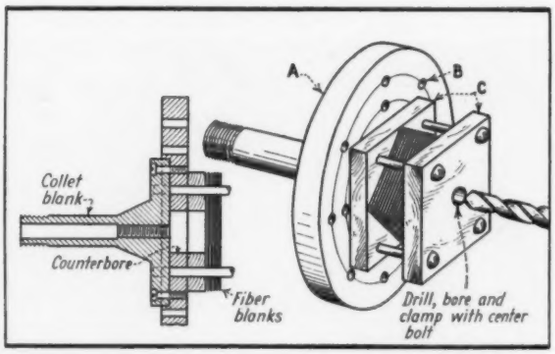
the variation can be obtained by using a height gage. Then the variation can be added to, or subtracted from, the measurement from the straight edge, thus giving the radius.

Accurate Washers from Thin Material

By LAURENCE F. SOUTHWICK

There is nothing new about the boring plate. But how many people know that it can be used successfully to bore and turn washers from thin material? We recently used it for making fiber washers.

We made a light faceplate of cast iron 5 in. in



This boring plate was designed to bore and turn accurately washers made of thin material. The faceplate is used as a templet for laying holes in the holding blocks

diameter and ½ in. thick. To this was bolted a collet blank as shown in the drawing. Eight radial lines were scribed on the faceplate, 45 deg. apart. Three circles, ½ in. apart were also scribed on the faceplate. Holes were drilled at the intersection of the circles and radial lines, every other hole being tapped. This allows the faceplate to be used as a templet if desired. The center of the faceplate is counterbored to permit drilling washers assembled as shown in the drawing.

The washers we made on this boring plate were of 0:015 in. fiberboard, 0.650 in. inside diameter and 1.370 in. outside diameter. The material was cut into squares slightly larger on the side than the finished diameter. Two square hardwood blocks *D* were cut large enough to give adequate stock for drilling through the corners to correspond with the holes in the faceplate. The holes in the block were scribed using the faceplate as a templet.

The two blocks and fiber squares are assembled as shown in the drawing, the four screws through the corner holes of the block clamping the assembly to the faceplate. The block and fiber squares are drilled and bored. After boring, the assembly is clamped by a bolt and washer. The outer screws are then removed. Excess material can be removed from the corners with a hacksaw prior to turning the outside diameter.

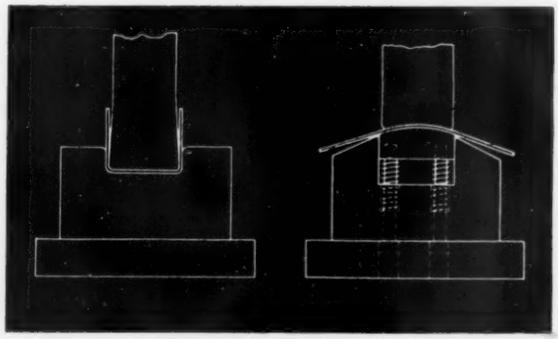
This plate can be used advantageously for boring a hole exactly concentric with an established outside diameter, or to any amount of eccentricity desired by reversing the above procedure. First clamp through the center and indicate the outside, dead true or eccentric, as desired. Then, using a metal ring instead of the wood pieces, replace the center clamp with outside screws and bore.

Compensating for Spring Back in Press Tools

By L. KASPER

In the press forming of flat stock into channel or similar shapes, the common design of forming die consists merely of a grooved block with a punch to force the material down into the groove. This, of course, is the simplest form of die construction, and in many cases proves entirely satisfactory, especially if the material is dead soft. However, if there is a tendency for the material to spring back after forming, the sides of the channel will not be formed parallel. In such cases, it is customary to relieve the punch in back of the forming corners in the hope, which is not always fulfilled, that the material will throw away from the forming corners of the die. One objection to this method is that sometimes it is necessary to fit the punch and die closely, so as to "iron out" the material, which usually leaves draw marks on the work.

At the right in the drawing is a die in which provision is made for the spring back of the material after

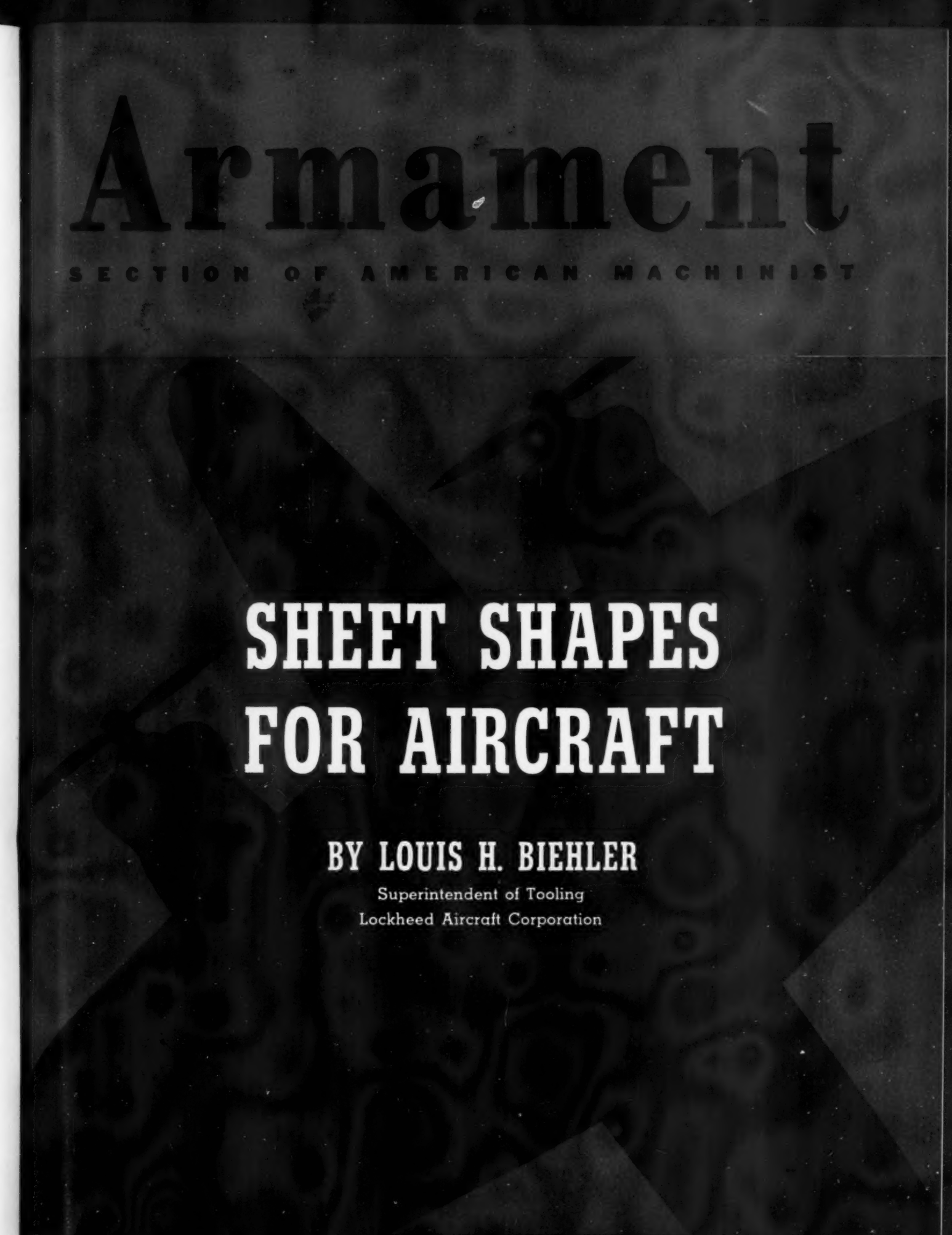


Although the punch at the left relieves spring back, it may leave draw marks on the work. With the die at the right the corners are formed while the bottom is held in a sprung condition, thus compensating for outward spring at the corners

forming. The work face of the punch is concave, and the face of the pressure pad is convex, the arc of these surfaces being determined by experiment and must not be sufficient to produce a permanent set to the material. The springs must be sufficiently strong to cause the material to conform to the curved surfaces before any forming is done on the corners. As the formed piece is removed from the die, the tendency is for the two sides to spring outward from the corners, but as the corners have been formed while the bottom is held in a sprung condition, the tendency is for the bottom to straighten out and throw the sides inward, thus compensating for the outward spring at the corners.

Armament

SECTION OF AMERICAN MACHINIST

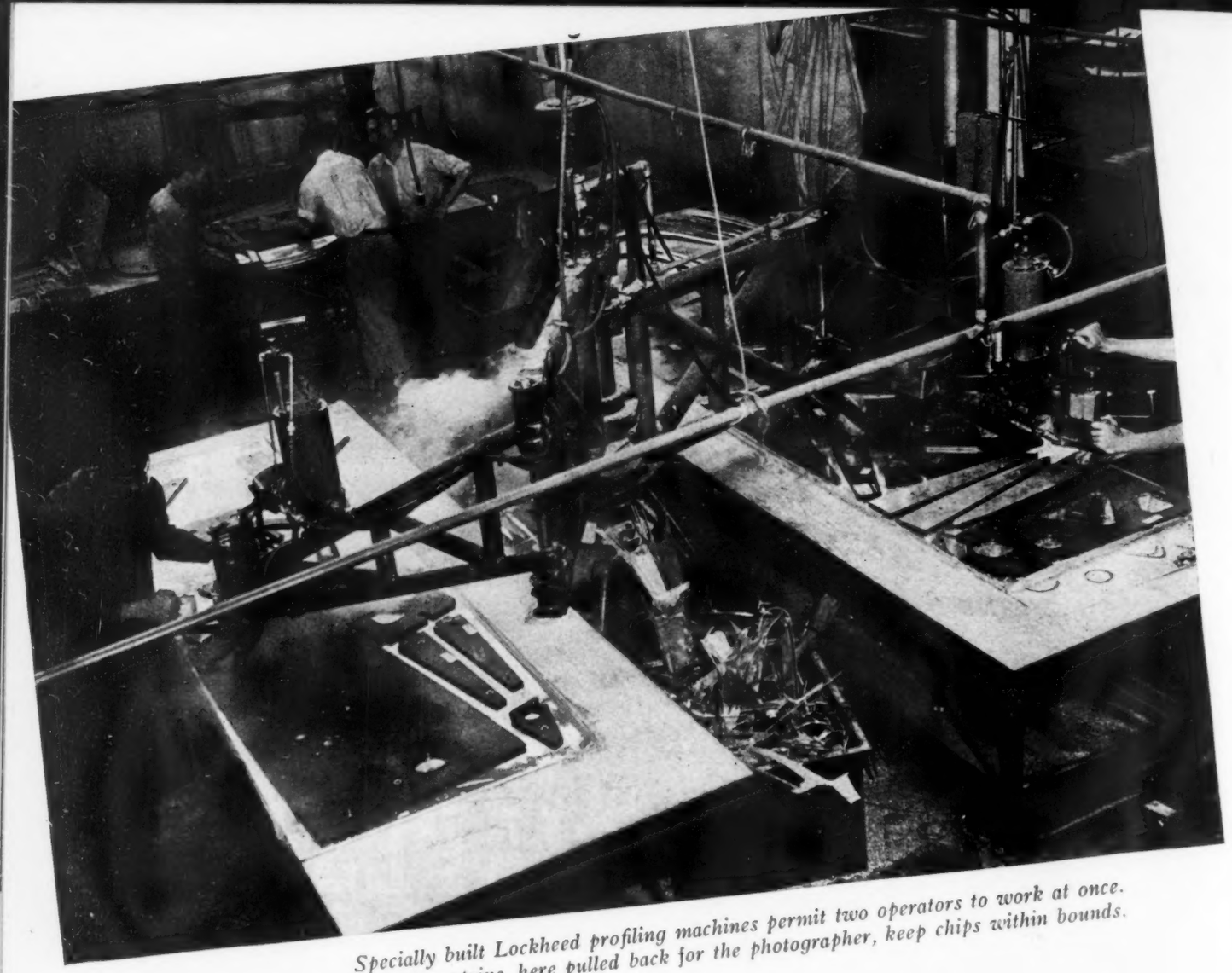


SHEET SHAPES FOR AIRCRAFT

BY LOUIS H. BIEHLER

Superintendent of Tooling
Lockheed Aircraft Corporation

also X-RAY IN AN ARSENAL and POSITION-THREAD GAGE



Specially built Lockheed profiling machines permit two operators to work at once. Canvas curtains, here pulled back for the photographer, keep chips within bounds.

SHEET SHAPES FOR AIRCRAFT

By LOUIS H. BIEHLER

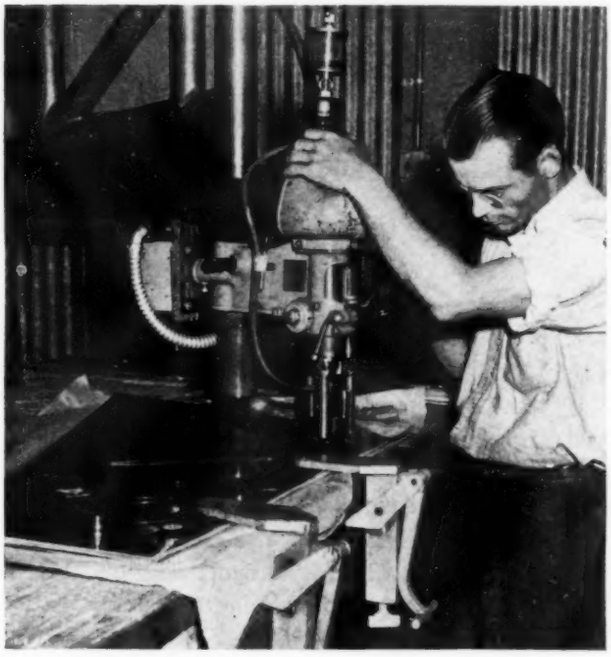
Superintendent of Tooling, Lockheed Aircraft Corporation

A special system of drilling and routing permits multiple profiling of many sheet aluminum aircraft parts. With this method small lots can be turned out efficiently

INCREASED USE of flat sheet stock in aircraft manufacture has made necessary improved means for manufacturing irregularly shaped blanks from rectangular stock. This problem is particularly difficult due to the complex shapes and variety of sizes required by aircraft design. Lockheed Aircraft Corporation, in common with other manufacturers of metal aircraft, has developed equipment specifically designed to meet the requirements of minimum tooling outlay, maximum flexibility, and low cost, rapid, accurate parts production. Its combination drilling and profiling equipment permits production of finished blanks, including multiple drilling operations, with only one handling of material. This not only reduces handling time but minimizes marring of the sheets themselves, an important consideration in aircraft.

The basic profiling principle is to stack a number of standard sheets on a table and to cut them all at once to the outline of a single pattern, using a router bit as the cutting tool. The process is sufficiently flexible to permit profiling a single sheet or a stack of fifteen. It is possible to arrange small patterns on a large layout so that only about nine per cent of the original stock is wasted.

The drilling and routing unit consists of a heavy central pedestal on which are pivoted two jointed arms to support router or drill heads. These machines were designed to specifications and built in the Lockheed shops with the cooperation of various tool and equipment manufacturers. Their construction is quite rigid, to permit steady movement of the router and to eliminate chatter. The joint on the swinging arm permits the tool to reach any point within a circle sixteen feet in diameter, except within twelve inches of the inner pivot point. Complete freedom of motion of the inner pivot is attained through large roller bearings, well protected from dirt and chips. The arm is equipped with cone adjustments on bearings at the pivot point and at the knee, to take up wear.



First operation in multiple-sheet profiling is drilling locating holes through a stack of blanks. Sheet metal templet is held with quick-acting clamps. Sheets will later be bolted directly to plywood routing table top

Operation of the machines is always in pairs; that is, both arms on one pedestal are used for routing, and both arms on another pedestal are used for drilling. This prevents chips from a routing tool from interfering with operation of a drill, whereas the router operators, being accustomed to a heavy volume of chips, are not disturbed by them. The stream of chips discharged by the routers is localized by canvas curtains around each pair of routers.

Special portable tables, 48x144 in., support the stacks of material for drilling and profiling. These table tops are the same size as standard aluminum alloy sheets. Tables may be moved about at will on suitable casters and locked in position by quick-acting jacks. Each table top is built up of heavy plywood to provide for attaching the stock by lag screws.

Special Heads Necessary

Drills are driven by an electric motor of about ¾ h.p. operating at 1,720 r.p.m., mounted at the end of the pivoted arm. A manually operated drill spindle carries a hardened steel bushing to locate the drill accurately and to maintain pressure against the stack of material. This improves accuracy and prevents drill chips from creeping in between the sheets.

The router head is driven at 15,000 r.p.m. by a high-frequency electric motor. This motor is mounted on vertical ways at the end of the pivoted arm, and may be raised and lowered manually for feeding the cutter into and clearing it from the work. This provides a degree of control over the tool head which permits extreme flexibility for internal and external profiling of complex shapes. Although most of the material handled is Dural or clad alloy, it is possible to rout such sheet materials as linoleum, copper, brass, Plexiglas, Micarta, Masonite, etc.

Actual cutting in profiling is accomplished by router bits. These bits are special single-lipped spiral-fluted end mills. Due to the speed at which they operate, they are provided with much greater rake and clearance than standard mills. They also have a slightly concave face. Best operation, from the standpoint of parts design and routing, is obtained with a bit about 5/16 in. in diameter. Although this size limits internal

cutout radii to 5/32 in., this does not interfere with design to any extent. A cutter of this size has sufficient strength and rigidity to withstand hard usage and fast cutting.

The quantity of work possible with these cutters depends to a large extent on their sharpness. As soon as the edge has worn off, speed and cutting smoothness decrease, overloading the motor and frequently resulting in the tool hanging up and breaking. Practice indicates that a bit may be used for routing Dural for approximately two hours per grind. Cutter grinding consists only of removing sufficient stock to renew the cutting edge. Cutters may be reground repeatedly until the land has been completely removed, after which they must be discarded. Minor changes in cutter diameter are compensated for by graduated guide collars on the chuck shank.

Guide Blocks Also Routed

Routing is done with individual guide blocks, against which the guide collar bears during cutting. These router blocks are usually made of sheet Masonite or wood about ½ in. thick. Individual flat layout templets serve as patterns for making these blocks. Most are cut on a wood shop router directly from these templets. In making the router blocks suitable allowance is provided for the difference in diameter between the router bit and the guide collar. Router blocks which involve aggregate cutouts or narrow sections are sometimes provided with a reinforcing plate to prevent distortion due to pressure of the guide collar.

Pre-drilling of stacked sheets before routing is done with a master drill templet. These templets are the same size as the stock sheets which are to be drilled. Flat layout templets for individual parts are grouped on a sheet of ¼-in. plywood, nesting together with about ½ in. of space between them. Enough templets are used to cover effectively the entire sheet surface. After the arrangement has been completed, these individual templets are riveted in place on the plywood. Templates carry all the hole layout required by the part design and, in addition, at least two 3/16-in. locating holes for securing router blocks during subsequent operations.

A typical work cycle for production of drilled blanks is as follows: The desired number of stock sheets are stacked on the router-drill table and the master drill templet placed upon the stack. This assembly is clamped firmly in position on the table by quick-acting clamps, and the layout is then moved to the drilling station and locked in place. The drill operator goes over the entire surface of the templet, drilling all holes as called for by a suitable drill size code. When drilling is complete, the table is moved away from the drill station to make way for the next table. The clamps are released and the master drill templet removed. Individual router blocks are placed in the proper positions and fastened by 3/16-in. lag screws which pass through the locating holes and engage the wood surface of the router table. An electrically driven wrench is used to insert and remove these lag screws.

When all blocks are in place the table is moved to the routing station and locked in position. The routing operator cuts the blanks by passing the router around the periphery and the internal cutouts of each block, making sure that the guide collar maintains constant bearing against the block. When all cutting has been done, the table is unlocked and moved to the unloading station. Here the lag screws are removed, the blocks taken off, and the completed blanks burred and stacked in racks. Metal remaining on the table consists principally of narrow strips of scrap which can easily be collected and salvaged.

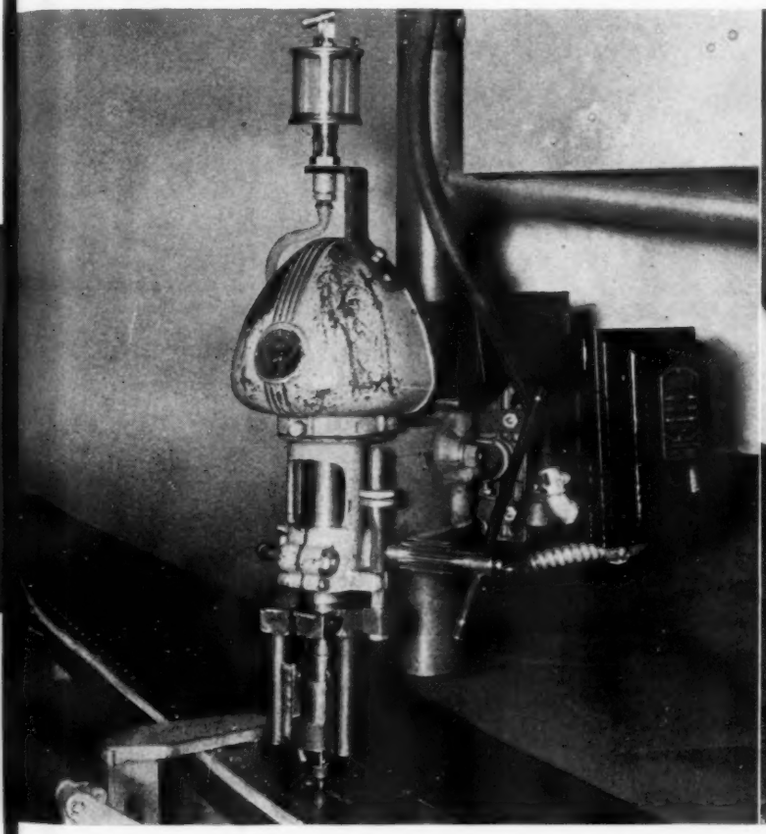
Special drill heads carry hardened steel drill bushings which compress work to prevent sheet separation and resultant burrs. Heads are interchangeable with router heads to provide greater flexibility. Drills operate at 1,720 r.p.m. In the set-up at far right the templet is held by both lag screws and clamps. Router bit is guided by a bushing bearing against the templet. Note clean edges and freedom from burrs. Part is a main wing spar member

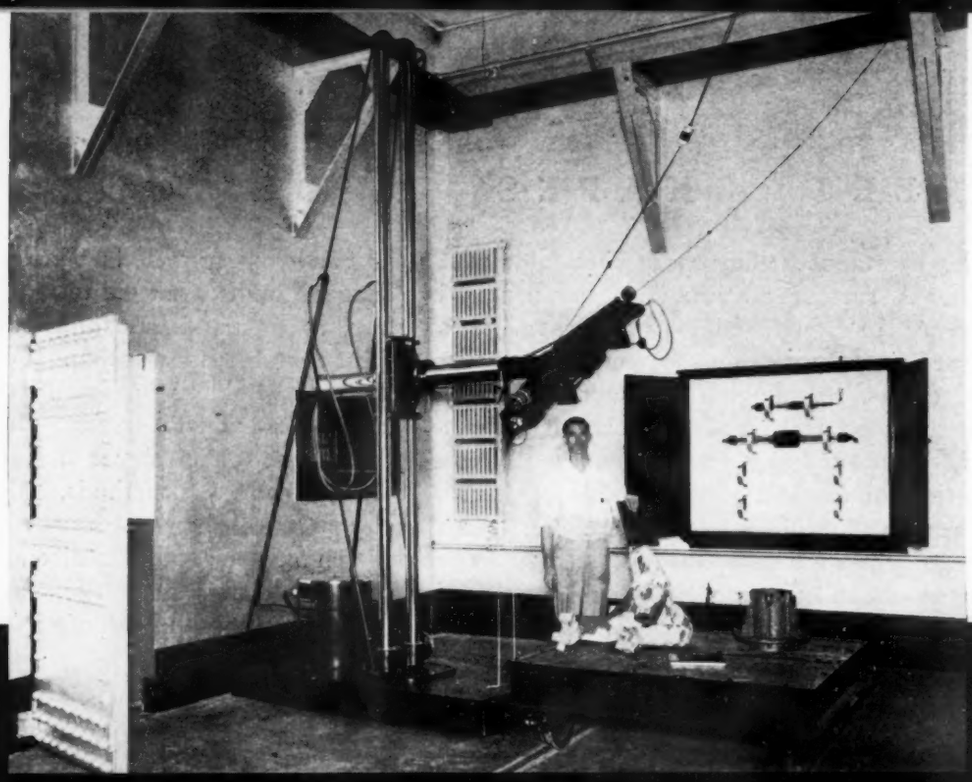
Blanks produced by this method are characterized by clean, smooth edges. Both drilling and routing can be done rapidly and accurately by an experienced operator, with

tolerances approaching those obtainable with dies. A further advantage is the practical absence of rough edges which sometimes cause fracture during subsequent forming operations. Although the routed edges are for the most part free from burrs, it is sometimes necessary to perform a burring operation on the top and bottom blanks in a stack, since the edge of each of these pieces is not adequately supported during cutting. For this work a machine has been developed which washes off all foreign matter and presses down the burrs between polished steel rolls. This unit also removes excess water and discharges the blanks ready for subsequent forming operations. Development of this machine has practically eliminated former slow hand burring.

A typical table layout may involve drilling and cutting as many as thirty or forty different blanks producing up to 600 separate pieces, and drilling as many as 3,500 holes. Such a set-up may be run through the drilling and routing cycle in a little over an hour. Enough tables are used to that loading, drilling, routing and unloading stations may be kept continuously working. It is thus possible to produce blanks for small lot production at a very low unit labor cost. In some respects the process also shows decided advantages over punch press methods.

There are many variations of this process which may be applied to aircraft work. Drilling and trimming large flat skin sheets, slotting tubing and milling irregular outlines and cutouts in extruded metal sections are typical of the work which can be done with this equipment. It has also been found advantageous to use an adaptation of the wood shop pin type router for trimming form parts, and for cutting small flat blanks which cannot be satisfactory secured to the router tables. For such uses it is necessary to provide special router blocks or jigs which secure the part in a nest to present the desired face or edge to the router bit.





X-RAY IN AN ARSENAL

ABOUT FIVE YEARS AGO Rock Island Arsenal installed X-ray apparatus as a part of its continued program for improving the quality of national defense material. Recent additions have improved flexibility and capacity.

The original installation, having a maximum capacity of 500,000 volts, is used for the investigation and inspection of castings and welded parts. Walls of the room in which this equipment is installed are of 24-in. concrete, with lead doors for maximum protection to the operator.

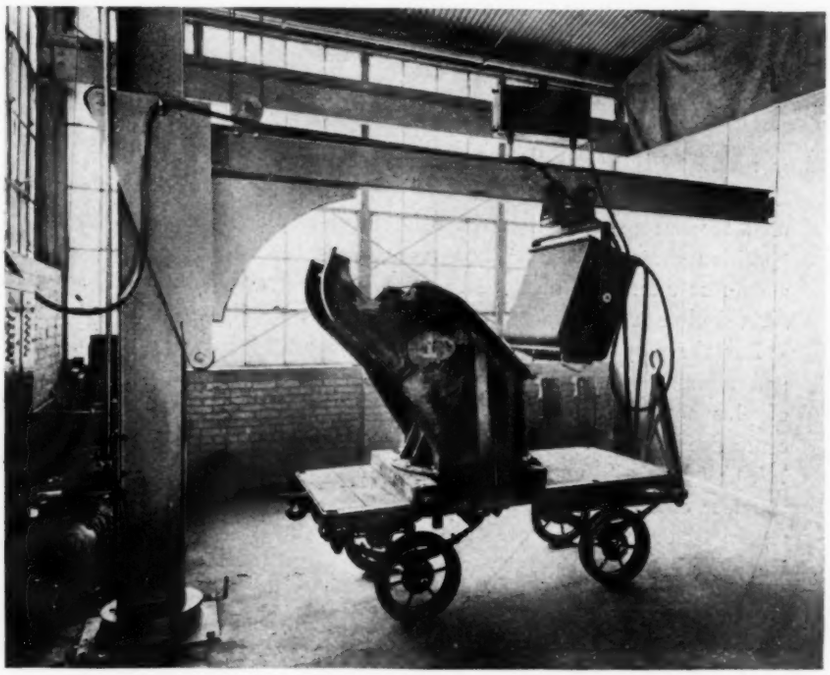
The new equipment consists of a complete X-ray laboratory adjacent to the welding shop. This equipment, having a 220,000 volt capacity, is used to inspect all stressed areas in gun carriages and other welded parts. Enough random views are taken to check uniformity of the welding. The installation provides maximum flexibility, and the arrangement of the complete X-ray department combines adequate space with compactness.

The tube itself is mounted in a shock-proof housing which has an 8-ft. travel on the arm of a jib crane. An electric lift with remote control makes it easy for the operator to change the vertical position of the tube. Since only secondary radiation is emitted from the tube housing, the outside two walls of the room—which have only an occasional passer-by—are not lined. The two working walls and doors are lined with $\frac{1}{8}$-in. lead sheets.

A standard rubber-tired shop trailer carries the parts into the X-ray room. The cart also makes a readily movable support for the parts under the tube. Trailers enter the room through a large sliding door which opens directly into the welding shop aisle. An electric motor and speed reducer drive a sprocket and chain which moves the door along an overhead track. Limit switches prevent overtravel. Safety switches are also used on the doors, so that the machine cannot be turned on unless the doors are closed.

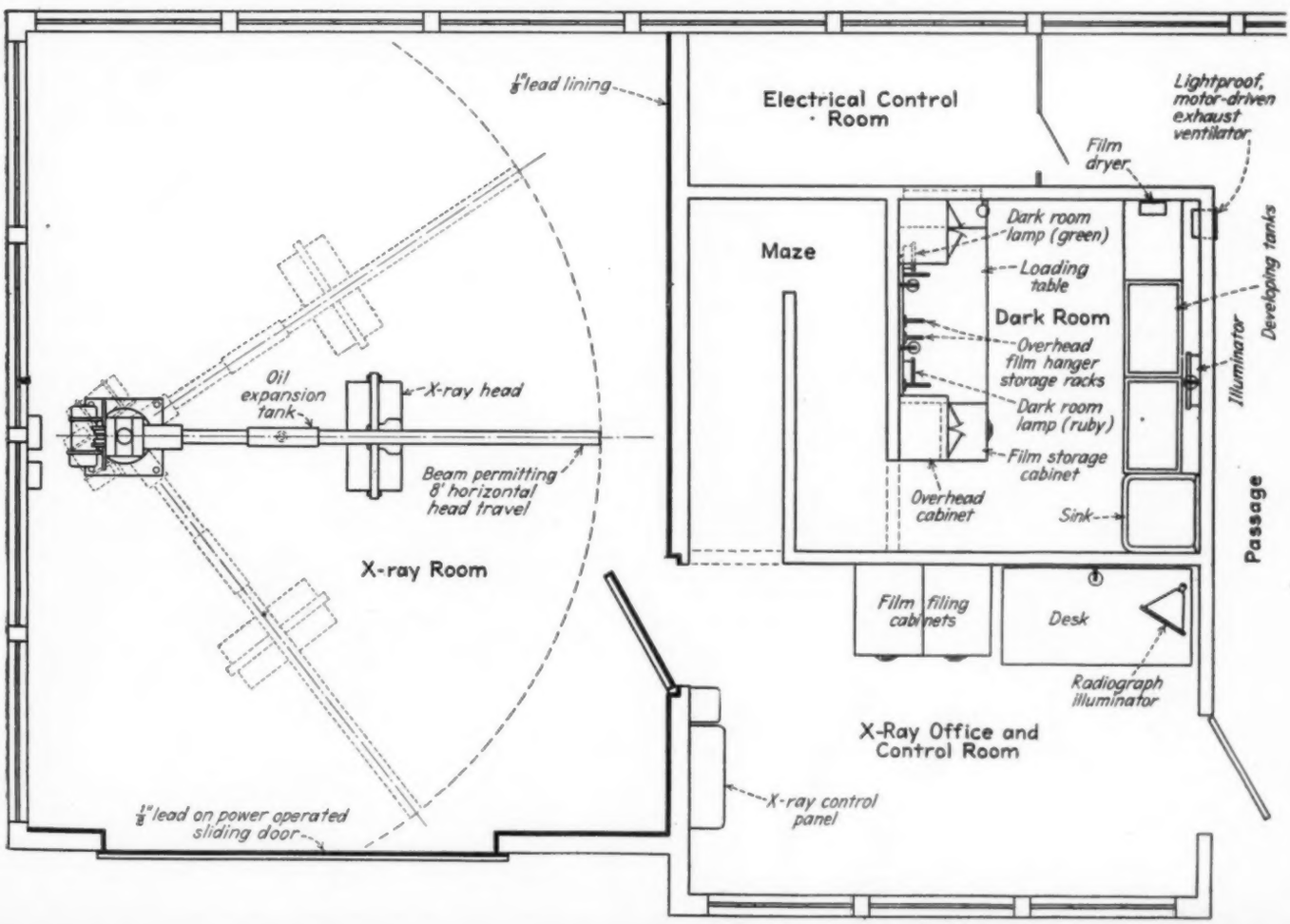
With the arrangement of the dark-room shown, it takes about 50 min. from exposure to finished negative. Watch temperature for film development is thermostatically controlled. Negative viewer has a rheostat so that intensity of viewing light can be controlled. Personnel required comprises one man in the X-ray room, one man in the dark room, and one-half time for a laboratory man to view the pictures.

A wide variety of cast and welded parts can be inspected in this 500,000-volt X-ray machine installed at Rock Island Arsenal



This 200,000-volt X-ray installation permits maximum flexibility for inspecting welds of many awkward-shaped castings. It is installed immediately adjacent to the welding shop. Lead sheets ⅛ in. thick prevent injury to plant personnel

Minimum space and maximum convenience are achieved in this compact layout of a complete X-ray inspection laboratory. Finished negatives can be viewed in less than an hour after exposure



Position-Thread Gage

Canada's method of making an accurate "check" for position-thread gages may prove helpful in American defense programs

MANY DIFFICULT PROBLEMS fall to the lot of a toolroom engaged in making inspection and machine fixtures for machine-gun parts manufacture. One of the "skullcrackers" solved by the toolroom in the Canadian-Bren plant is the method of making the *check,* or master piece, used for setting up both types of fixtures employed on work involving "position threads." A position thread may be defined as one in which a definite dimension must be maintained between a point on the thread helix angle and either an end face or some other location on the piece.

For the gun component sketched, dimension *A* between the end face and reference point *B* on the thread helix angle may have a tolerance of plus nothing, minus 0.002 in. Moreover, point *B* must lie on the centerline of the cross slot within a minute or two of arc.

The major difficulty centered about making a fixture for grinding the end face of the check, at a definite dimension from point *B* and with due regard to the angular position of the cross lot. The following solution was worked out after much study:

A rectangular steel block is ground with all six sides square within a tenth, and a through hole bored square with the sides within a tenth. A slot is milled in one end of the block and a cross-pin hole is drilled at approximately distance *A* from the end face. Two steps are ground on the end of the block, one equal to distance *A* from the crosspin hole and the other a tenth of an inch less.

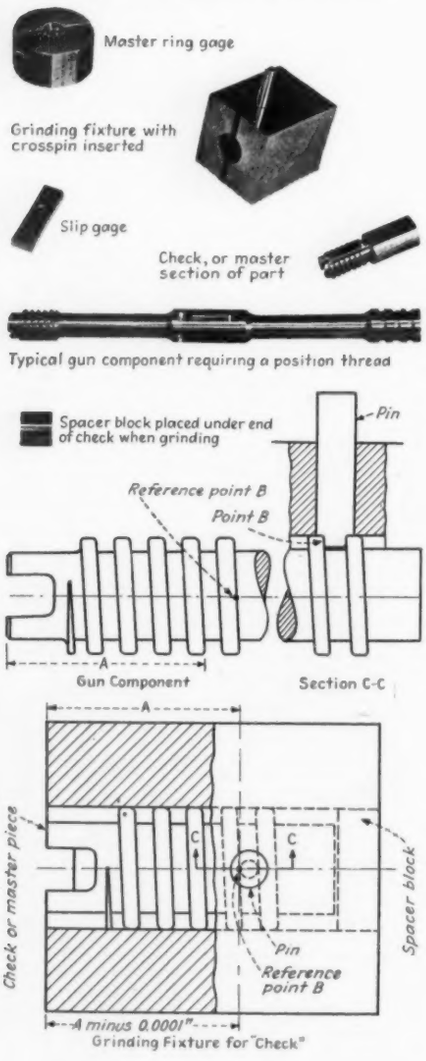
To grind the check, the part is inserted into the larger hole, with the slotted end clearing the stepped end of the block. A slip gage is inserted in the slots in the end of the block and work, after which an accurate cross pin is inserted in the cross hole so that a tit firmly bears against the thread flank at point *B*. It is now a simple matter to grind the tongues of the check flush with the respective steps on the block.

The check is used in setting up machine fixtures as follows. Prior to milling the slot on the gun component, the check is screwed into a ring-gage element in the fixture. Then a spotting face is positioned against the end of the check. Thus, when work is screwed into the fixture and against the spotting face, it protrudes the correct distance for milling the slot. The same general idea is used when setting up to grind the end face.

Inspection fixtures have adjustable locating surfaces that are positioned daily in relation to the master check. For example, the check is laid in the fixture and a master ring gage of correct thickness is screwed onto the check, so that the slots can be aligned with a slip gage and the surfaces of check and ring gage are flush. Next, locating surfaces in the fixture are positioned against the master ring gage. Upon removal of the check and master ring gage, work pieces can be laid in the fixture and a ring gage run onto the threaded end and against the locating surfaces, to establish that dimension *A* is being maintained in production, and also that other dimensions bearing a relation to dimension *A* are coming within established tolerances.

Without an accurately made *check* it would be impossible to establish accurate setups on position-threaded work, either for machine or inspection fixtures. But before an accurate *check* could be made, a method of producing its grinding fixture had to be developed.

ELEMENTS OF CHECK AND ITS GRINDING FIXTURE



Dimension A, *on the gun component, must be within 0.002 in. of the specified dimension. Point* B *must be held close to centerline of cross slot*

Pressures and Blanks for Press Work

Courtesy of The Cincinnati Shaper Company

TONNAGES PER LINEAL FOOT FOR BENDING MILD STEEL WITH AIR-BEND DIES *

Thickness of Metal		Width of Female-die Opening, In.																						
Gage	Inches	1/4	5/16	3/8	7/16	1/2	5/8	3/4	7/8	1	1 1/8	1 1/4	1 1/2	2	2 1/2	3	3 1/2	4	5	6	7	8	10	12
20	0.0375	3.12	*2.25*	1.68	1.43	1.10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	0.0500	5.31	4.00	*3.00*	2.47	2.22	1.74	1.28	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	0.0620	9.59	7.08	5.55	4.50	*3.75*	2.78	2.18	1.77	1.47	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	0.0780	.....	11.90	9.23	7.58	*6.25*	*4.68*	3.47	2.98	2.45	2.11	1.84	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	0.1090	.....	.....	.....	16.70	13.10	9.69	8.02	*6.54*	5.56	4.58	4.06	3.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	0.1250	.....	.....	.....	.....	19.20	14.20	11.10	8.99	*7.50*	6.34	5.54	4.35	2.94	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	0.1410	.....	.....	.....	.....	.....	18.60	14.50	11.90	9.94	*8.46*	7.29	5.77	3.95	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3/16	0.1875	.....	.....	.....	.....	.....	.....	27.40	23.10	19.30	16.40	14.30	*11.20*	7.50	5.70	4.40	.....	.....	.....	.....	.....	.....	.....	.....
1/4	0.2500	.....	.....	.....	.....	.....	.....	.....	.....	39.40	33.30	29.50	22.70	*15.40*	11.40	9.00	7.35	6.06	.....	.....	.....	.....	.....	.....
5/16	0.3125	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	50.40	39.80	27.00	*19.70*	15.30	12.70	10.50	7.74	.....	.....	.....	.....	.....
3/8	0.3750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.60	42.30	30.90	*24.00*	19.60	16.30	12.30	9.46	.....	.....	.....	.....
7/16	0.4375	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	61.70	45.80	35.40	*28.60*	24.40	17.90	14.80	11.20	.....	.....	.....
1/2	0.5000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	85.20	63.60	48.80	39.70	*33.30*	24.60	19.40	15.90	13.10	.....	.....
5/8	0.6250	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	110.00	86.20	70.00	58.30	*43.10*	33.30	27.40	23.30	16.90	.....
3/4	0.7500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	138.00	110.00	93.00	68.70	*53.50*	43.60	36.50	27.10	21.00
7/8	0.8750	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	165.00	137.00	104.00	80.70	*64.60*	52.90	39.70	31.60
1	1.0000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	197.00	143.00	113.00	91.20	*76.20*	56.30	44.20

a The tonnages underlined are for V-die openings eight times the thickness of the metal. These generally are used for average right-angle bending work.

PRESS BRAKE tonnages required per lineal foot of stock to make simple single bends in mild steel are given in the table. Mild steel, having a tensile strength of 55,000 to 65,000 lb. per sq. in., is used as the standard, since the bending pressure varies directly as the tensile strength of the material. For example, for any material having a tensile strength of 90,000 lb. per sq. in., the tonnages in the table should be increased 50 per cent.

The tonnages given are based on using "air bend" dies, which contact the metal only at the point of the male die and the two points of the V-die. All the pressure exerted is put into forming the metal; none for squeezing it. The dies are said to be standard when the opening is eight times the thickness of the metal to be bent. The tonnages underlined in the table are those for standard V-dies; thus, 7.5 tons per foot of length is required for bending $\frac{1}{8}$-in. mild-steel stock in a V-die with a 1-in. opening. For bending the same stock in a V-die with an opening five times the thickness of the stock, that is $\frac{5}{8}$-in., 14.2 tons per lineal foot would be required.

Approximately, the pressure required varies inversely as the V-die opening. Enlarging the opening to twice the standard, reduces the pressure more than one-half. Reducing the opening to one-half standard, more than doubles the pressure.

The pressure required varies directly as the metal thickness. Twice the thickness increases the pressure more than four times, while one-half the thickness decreases the pressure to less than one-quarter.

The pressure varies directly as the length of the stock. Twice the length requires twice the pressure, and one-half the length requires one-half the pressure.

The inside radius of a bend is approximately 5/32 of the V-die opening regardless of the gage of the metal being formed. If a $\frac{1}{8}$-in. plate and a $\frac{1}{4}$-in. plate were formed over a 2-in. die, each would have the same inside radius—approximately 5/16 in.

When bending ordinary mild-steel plates more than $\frac{1}{2}$ in. thick, it is as a rule necessary to use a die opening greater than eight times the thickness of the plate to prevent

RESOURCES *for* RESEARCH

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Pressures and Blanks for Press Work

fracture. High-tensile steel plates, even in the thinner gages, must be formed over die openings ten to twelve times their thickness.

Special flanging or boiler steel is often used to eliminate breakage when necessary to bend heavy plate over small die openings.

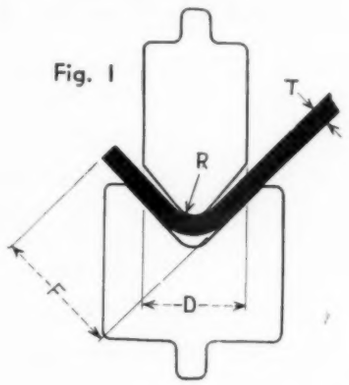
When making a 90-deg. bend, the pressure rises very rapidly. It reaches 85 per cent of maximum when the metal is bent only 20 deg., and the maximum when bent 40 deg. The pressure drops only a few per cent when metal is bent 90 deg.

If the dies are struck solidly together, there is no limit to the pressure that can be applied.

Length of Blanks

Following are data on the use of V-dies and the calculation of the developed width of sections so formed. The standard V-die opening in press brake work is eight times the thickness of the metal; that is, referring to Fig. 1,

Fig. 1



$$D = 8T$$

When this is done, the inside radius R on the work will be governed by the die width as follows:

$$R = 5/32\ D$$

If the radius on the male die is greater than $5/32D$, then the work will follow the male die but will distort if the radius becomes very large. In Fig. 1, the minimum flange F possible to form can be determined by the formula

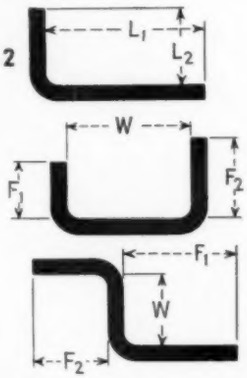
$$F = (D/2) + 2T$$

The pressure in tons per foot of length for forming mild steel on V-dies are given on page 933.

Blank Calculations

If the inside radius on the work approximately equals the gage of the metal, that is $R = T$, then for

Fig. 2



shapes shown in Fig. 2 the developed width can be found as follows:

For angles

$$\text{blank width} = L_1 + L_2$$

For channels

$$\text{blank width} = W + F_1 + F_2$$

For Z-bends

$$\text{blank width} = W + F_1 + F_2$$

Note that all dimensions are to the inside. The great majority of V-die work will fall in the foregoing classes. To layout bend lines, the bends are marked on the inside of the work using inside dimensions of work as shown in Fig. 2.

If the radii differs much from $R = T$, some correction must be made. A general method of calculating blank sizes on straight sections where the radii are not the usual size, as assumed above, is as follows:

$$\text{Blank width} = (W + F_1 + F_2) - [3T + (R/2)]$$

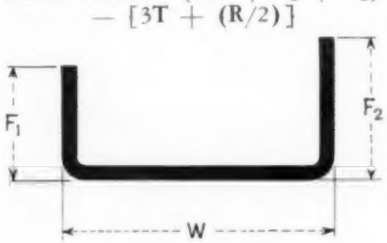
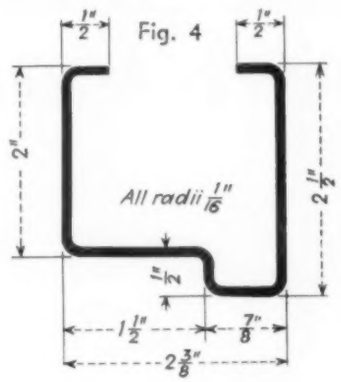


Fig. 3

where the dimensions are to the outside as shown in Fig. 3. To use this formula on multiple bends, add all outside dimensions around the piece and deduct $[3T + (R/2)]$ for each two bends involved. For example, take the shape shown in Fig. 4, bent from 1/16-in. stock. Adding the outside dimensions around the section, beginning at the upper left-hand corner

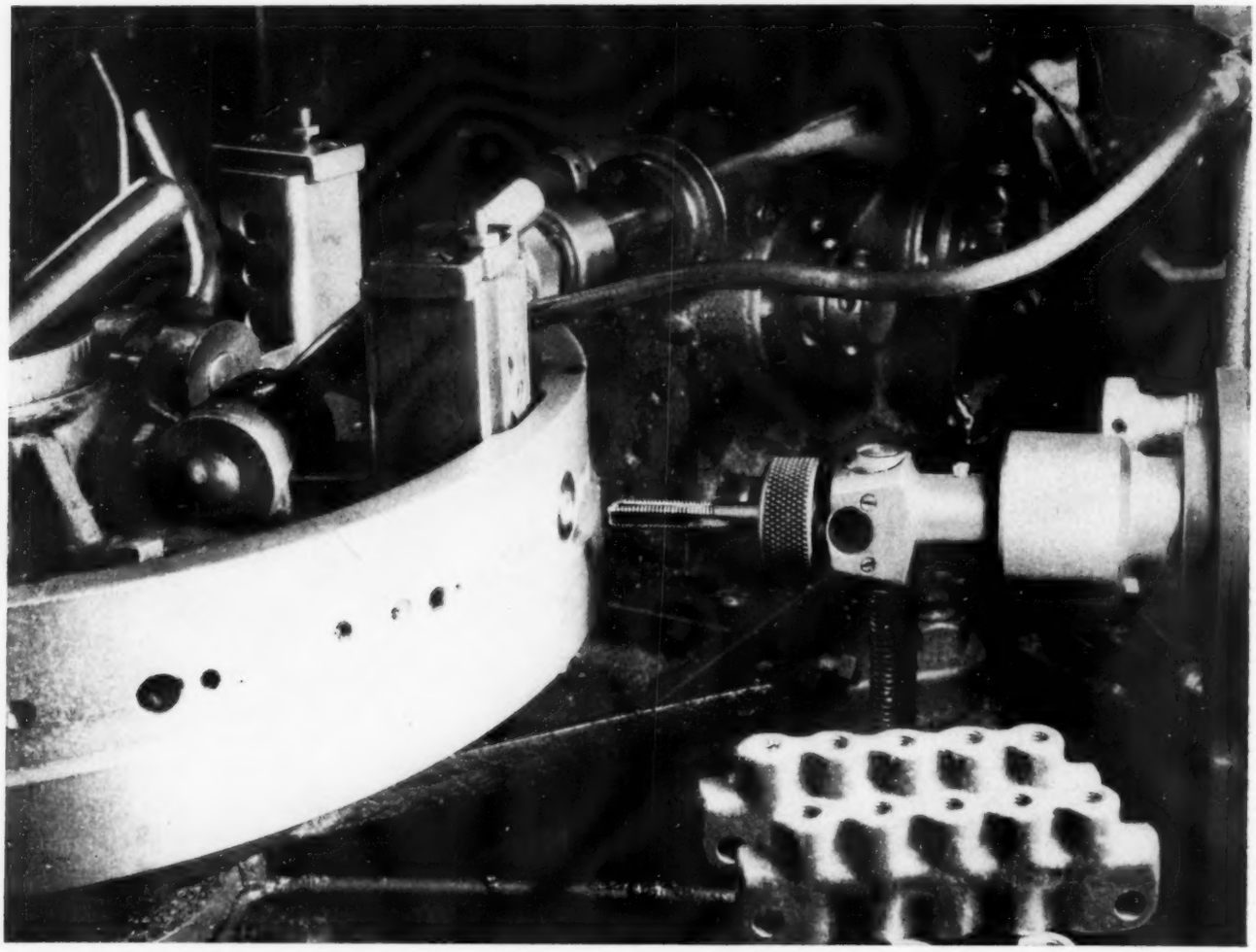
First straight section	0.500 in.
Second straight section	2.000 in.
Third straight section	1.563 in.
Fourth straight section	0.563 in.
Fifth straight section	0.875 in.
Sixth straight section	2.500 in.
Seventh straight section	0.500 in.
Total	8.501 in.
Deduct six bends, $3[3T + (R/2)]$	0.656 in.
Blank width	7.845 in.

Fig. 4

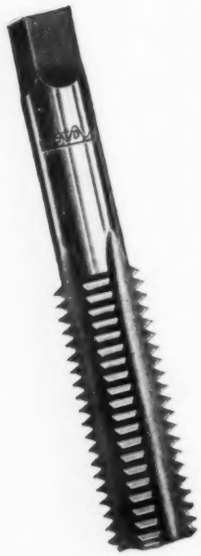


Allowances for bends made across the grain in mild steel, using V-dies, are as follows:

Gage, T	Radius, in., R	Allowance, in.
24	1/32	0.062
22	1/32	0.065
20	1/32	0.070
18	1/16	0.120
16	1/16	0.131
14	1/16	0.139
13	3/32	0.196
12	1/8	0.254
11	1/8	0.262
10	5/32	0.295
5/32	5/32	0.327
3/16	3/16	0.393
7/32	7/32	0.508
1/4	1/4	0.524



"GTD Greenfield" Taps Chosen for this hard job



Here's a ten-way double junction casting turned out by a big specialty manufacturer — 10 tapped holes in each cast-iron piece. To handle it economically calls for a real investment in tapping machinery and fixtures *plus good taps.* The company saves itself money by using *"GTD Greenfield"* 5/16-24 Ground Thread High Speed Steel Bottoming Taps — to the tune of 240 completed tapped holes per hour.

Don't make the mistake of figuring tap "savings" on the cost of the taps. Figure on cost per tapped hole. *"Greenfield"* can help you get your costs down on this basis — and will be glad to work out test runs on your own work to prove it.

GREENFIELD TAP & DIE CORPORATION, Greenfield, Mass.

Detroit Plant: 2102 West Fort St. Warehouses in New York, Chicago, Los Angeles and San Francisco. In Canada: Greenfield Tap & Die Corp. of Canada, Ltd., Galt, Ont.

GTD GREENFIELD

TAPS . DIES . GAGES . TWIST DRILLS . REAMERS . SCREW PLATES . PIPE TOOLS

Let's Look at the Record

FOR THE first time John Public is reading about machine tools. Also for the first time his son or daughter is being asked by school teachers to write about "machine tools and defense." When an industry rates special attention in the schools something must be happening. When newspapers give it space along with air raids, politics, murders and comic strips, it must be NEWS in capital letters.

The machine tool industry *has* made news the past year! And it is the kind that renews one's faith that the system of private enterprise hasn't lost its virility, its resourcefulness and its ability to meet a crisis, despite the buffeting taken during the depression.

Let's look at the record.

The machine tool industry numbers less than 250 companies with a total investment not exceeding the cost of two battleships—$150,000,000. Its volume of business on the average is only $100,000,000 a year, which is less than Ford parts sales (not to mention Ford cars).

It has no Pittsburgh, no Akron, no Detroit. Its relatively small plants are scattered over a considerable part of the country east of the Mississippi and north of the Ohio. It employs in a moderately good year some 50,000 men, or fewer than walk through the gates of Chrysler Corporation any normal working day.

In the worst depression year the industry's orders fell to a mere $22,000,000. Average earnings the last decade were not even respectable. This in the least predictable of industries, whose ups and downs would quickly drive a Dr. Gallup to raking leaves if he tried to forecast the trends.

Then came the clarion call in September, 1939, when the war broke. The call grew louder as our defense program took shape. For nothing is more vital to defense industries than machine tools.

Here is how the industry responded: it increased its manpower by thousands and went to multiple shifts. New talent was trained, and still is being trained, by the hundreds. Millions were invested in new machine tools to speed work.

New plants and additions were erected, though managements realized that only the emergency warranted more capacity and that the increase of over 30 per cent would be "excess baggage" when business returned to normal. Work was farmed out in large quantities. The subcontracting system for parts and subassemblies spurred production greatly.

Following the pattern of 1917-18, new companies have been attracted to the machine tool manufacturing field because of the unprecedented volume of orders, and they will make their production felt in the coming months.

The results? This small industry has been enlarged, entirely without government funds, to a point where in 1941 it will turn out in excess of $500,000,000 of machine tools. It is still in the process of providing more capacity. Today no country has a machine tool industry which challenges it in size or quality of product.

It is this industry which has won Mr. Knudsen's highest praise for its defense performance. It is this industry which is putting into the hands of companies with defense contracts the most productive and the highest quality tools the world has ever seen. It is this industry which has voluntarily put into force a preference rating system designed to supply defense agencies with what they want ahead of all other customers.

If other industries will discharge their defense obligations as rapidly and efficiently as machine tool builders, we need entertain no fears that the armament program will be carried through without unnecessary delay.

Burnham Finney

GAGING BUSINESS

Election results likely to speed up metal-working operations as pressure is applied for quicker rearming and for more aid to Britain. Monthly machine tool output totals $40,000,000.

Metal-working operations will be further stimulated as a result of the national election. The Administration is expected to bring increased pressure to speed up defense preparations and to give more aid to Britain. From now on through the Winter the biggest problem facing metal-working plants will be squeezing out just as much production as possible. Output should be sustained at an all-time high level.

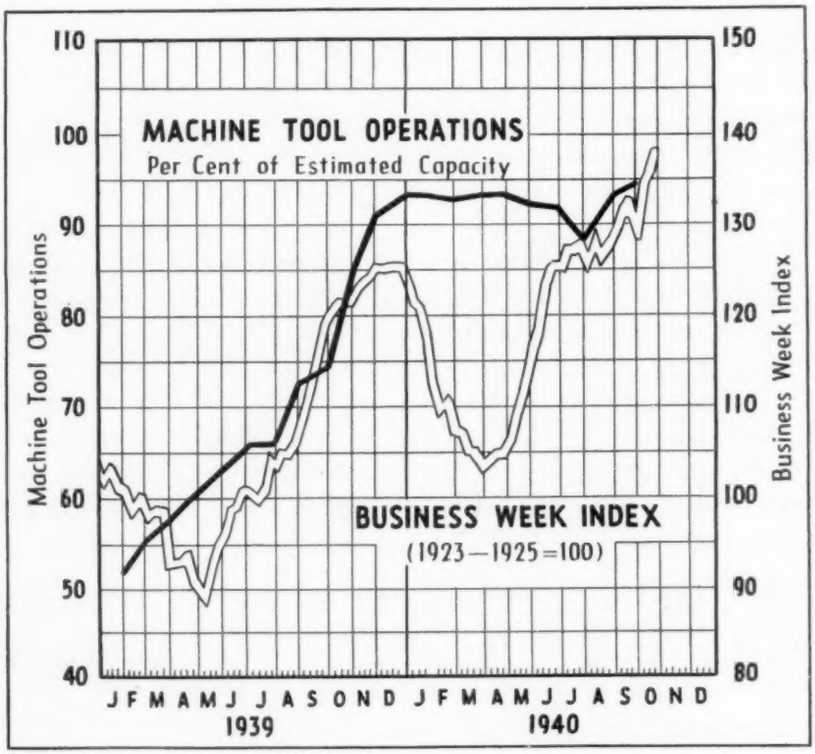
Machine Tools—October was the biggest month in history for many machine tool builders. Hardly any diminution in the volume of orders is looked for during the next few weeks, if inquiries can be taken as a criterion. Most of the unprecedented bookings by the industry stem directly from aircraft, munitions and shipyard needs in connection with the defense program. The first to place machine tool orders for defense work were companies along the Atlantic seaboard, where contract awards were heavily concentrated. Lately, however, defense business has spread into the middle west, and machine tool sales have been on a huge scale in the Pittsburgh, Detroit, Chicago and St. Louis areas as well as along the east coast. Whereas not so long ago export orders accounted for 30 to 50 per cent of the industry's total, now they have fallen to 15 per cent. Few machine tools except those destined for England or British dominions are going out of the country. Deliveries to England are being speeded this month, but opinion is growing that machine tools should be kept in the United States where munitions can be made for Britain without danger of bombings. Reliable reports from England, on the other hand, say that a surprisingly small number of machine tools have been put out of commission or destroyed by German bombers. The industry is now producing close to $40,000,000 of machine tools a month, though an average year's business is not much over $100,000,000. Plant capacity has been expanded more than 35 per cent since the war started. Shortage of trained men has prevented some companies from going to three shifts.

Railroad Equipment—Except for track materials for 1941 delivery, buying has tapered. With car loadings expected to be good next year, carriers are planning for reasonably heavy purchases of cars and locomotives.

Aircraft—Plane and engine orders have passed the $3,000,000,000 mark, a figure little dreamed of a year ago. Bookings are still steadily mounting. Ford, for example, has just been officially awarded a $125,000,000 contract for Pratt & Whitney motors, production of which will begin next spring. At a time when aircraft people are rushing new plants to completion, the automotive industry is being drawn in as the spearhead in a program to provide Britain with an additional 12,000 planes over and above previous commitments. This program, calling for building of parts and subassemblies by motor car companies, will require erection of many new plane assembly plants, perhaps as many as 15, probably in the Detroit district. The training of some 300,000 men, needed by companies in or doing work for aircraft manufacture, presents one of the serious problems.

Steel—Steel mills are operating at an all-time high. Both U. S. Steel and Bethlehem have been running above 100 per cent of theoretical capacity. Executives are confident that defense needs can be met without increasing basic steel capacity. Aside from possibility of a tight squeeze for a short time next spring, the industry believes it can take care of estimated defense tonnage and at the same time supply all the non-armament industries and the export trade. Some 40 per cent is being added to electric furnace capacity. This is in anticipation of large alloy steel orders.

Munitions—Army and Navy contracts have been placed in tremendous volume lately, particularly for artillery ammunition components. Lansdowne, Steel & Iron Co., Morton, Pa., has a War Department order for ammunition components totaling $17,283,750, Willys-Overland for $8,820,040, Budd Wheel Co. for $7,818,380, Tennessee Coal, Iron & Railroad Co. for $5,823,600, and Le Tourneau Co., Toccoa, Ga., for $4,569,290. Because of the unavoidable tooling-up process, manufacture of munitions will not be under way on a large scale until some time in the first half of 1941. Subcontracting of munitions business is aiding many industries. Five makers of printing equipment, for example, have munitions orders.



Aircraft Production To Be Aided by Auto Industry As Present Plane Output Lags

BY ROBERT COLBORN

WASHINGTON — The airplane program is going to be stepped up—perhaps almost doubled. The auto industry is being called in to do the job. The dimensions, even the objectives and methods, of the new program are still hazy. What is established is that the administration, and Knudsen, are dissatisfied with the present output of aircraft. The industry is falling behind the schedule set up, and Knudsen at least is not convinced that they will catch up to it. On the basis of his tours of the plane factories, he feels that the airplane people don't know enough about quantity production, and he is turning to Detroit for that knowledge.

The whole thing, of course, is contingent on Congressional action, but this will doubtless be forthcoming. Probably late this month Congress will be asked to appropriate some three billion or more for plants and aircraft.

It is fairly definite that the new program will include 12,000 bombers. Of these 8,000 will be two-engine ships of a model probably based on the Martin B-27, while 4,000 will be four-engine "Flying Fortresses," perhaps following the design of the Consolidated B-24. In addition there will likely be some 8,000 airplanes of a pursuit type. These 20,000 planes would nearly double the 25,000-odd combat ships included in the present 35,000-plane program. There is some talk of including a contingent of trainers, perhaps some 10,000, in the new program. Of the new ships, 12,000 are scheduled to go to the British—5 or 6,000 bombers and the remainder pursuit.

Will Make Aircraft Parts

To the auto industry has been assigned the production of parts for these planes and of sub-assemblies running up to tail and wing sections. The idea is that general purpose machine tools can be made available by more intensive utilization of machinery now on auto production. For instance a stamping press may be free for other uses by working three shifts on another press. It is not thought that production of dies would offer any great problem, since the Detroit tool and die shops, with some 10,000 workmen, are at low activity.

Final assembly cannot be done in the auto factories, and new assembly plants are going to have to be built —perhaps as many as 15 or 16—with British and U. S. funds. The plant expansions already planned cannot handle this added job, except in the unlikely event of complete re-scheduling of the existing program, and the new plants will probably be in the Detroit area. Finding management for these plants is going to be difficult. It will have to be drawn from the aircraft industry, and that industry's executive and supervisory forces are already spread out so thin as to have an adverse effect on production.

It may be that the new plan will be treated as an emergency program aimed exclusively at immediate production. In this case, the production methods of the airplane industry would probably be duplicated, and little effort made at real mass production.

On the other hand, it may be decided to rely on the program now under way for immediate output and aim the new plans at the future, at building up a big capacity perhaps a year from now. This would imply some procurement of special purpose tools, restudy of production methods, probably some re-design to facilitate mass production.

If the latter course is adopted, the final result might be some such set up as that in Germany, where one branch of the industry develops and tests new models, while another grinds out standardized types. It might also segregate the excess capacity of military needs over civil into a few government-owned plants which could be held in stand-by condition when the war's over.

NAVY WAGE INCREASE

WASHINGTON — In its first general wage adjustment since 1929 the Navy will raise the pay of 44 classes of skilled and semi-skilled workmen and mechanical supervisory personnel outside of civil service. The purpose is to line up Navy wages with those paid by industry in the same locality. Some observers think that private business must now raise its wages to hold its men.

Unused Production Facilities May Be Employed by Sub-contracting

WASHINGTON—As defense production expands into more and more sectors of the country's economy, subcontracting becomes the major means of drawing into the program facilities now unused and of diverting to defense of production for civil use. It is by this means that the resources of the small firms are made available. The Defense Commission is now shifting its attention to this phase. Donald Nelson has had added to his multitudinous jobs that of Director of Small Business Activities. Acting through special officers in Federal Reserve banks, he will give small business men advice on the work needed, financing methods and the like. Because it is desired to draw on now unused capacity before disrupting civil production, a survey of machinery and men available in areas where major industries have shut down has been initiated.

Wide World

Guns For The Navy—*Finished guns of large caliber await shipment in the Washington Navy Yard above. This is just one of the eleven Navy arsenals throughout the U. S. producing guns for the proposed two-ocean fleet. The photo was taken by the National Defense Advisory Commission*

Cargo Ship Assembly Yard May Be Built Here By Britain; See Demand for Unskilled Labor

WASHINGTON — Great Britain is about to set up a 28-way cargo ship assembly yard on this side of the Atlantic, probably in the United States, to turn out "pointed boxes" at a fast rate. The roughly-designed bottoms would use mostly common labor, so as not to cut in much on U. S. skills, and would represent a minimum loss if sunk. Parts would be built in various sections of this country and Canada by plants not loaded with other defense jobs and shipped to the yard for assembly.

The British, not yet short of cargo space but seeing difficulties a couple of years ahead at their present rate of loss, sent four commissioners to see Treasury Secretary Morgenthau. Evidently Britain's plan had the Administration's blessing. Morgenthau sent the commissioners to Admiral Emory S. Land, chairman of the Maritime Commission, for advice, which the Admiral is well qualified to give, since his experience covers both Naval and merchant ship building.

Baltimore, New Orleans, Portland, Oregon, and Los Angeles have been named by informed commentators as the possible locations of the British plants. The project would be privately financed. J. P. Morgan and the Dawes Brothers' Chicago banking firm are reported as interested.

Skilled Labor Is Greatest Problem

Washington authorities, questioned by AMERICAN MACHINIST, explained how problems incident to the British project will be met. Skilled labor supply is most crucial, of course. The British ships will have hardly any of the refinements of our own C-1, C-2, and C-3 designs; they will be little more than powered scows. Evidently, the British themselves dubbed them "pointed boxes." They will be substantial enough: riveted steel hulls with an engine, a deck, and a lot of freight space.

After skilled labor, the next most serious problem will be machine tools for those plants that will turn out the power and propelling machinery for the ships. One partial answer will be to call upon firms that make boilers, shafting, etc., for other marine purposes. Reciprocating steam engines, and oil engines, both in lower horsepower classes, might be built by non-marine firms. These companies already have their tools. But new tools will be needed, and at that point the British program is certain to meet up with the Priorities Board.

Just how far the Administration will permit the British plants to interfere with U. S. Naval and Maritime Commission building programs depends on the extent of its conviction that our line of defense is the English Channel. Leaving that to Mr. Roosevelt and Congress and the turn of events, both Navy and the Commission say they can get along.

The Navy has loaded up all the big yards with its two-ocean order for war ships, but is about to distribute the balance: plane tenders, mine sweepers, tugs, rescue boats, etc., to smaller yards. Navy has filled in a big construction gap by the purchase recently of the entire fleet of 12 Standard Oil tankers—best and most modern oilers in the world; of 30 auxiliary and supply vessels, including several yachts; and of about 30 additional such vessels now being negotiated. These purchases include a number of the modern C-ships which were built by the Maritime Commission. The C-ships are readily convertible for Navy service. Navy says it is ready for action in the Pacific now.

The Maritime Commission admits it will meet with difficulties but definitely will maintain its 50-ships-a-year schedule. Navy will elbow the Commission out of some yards, when boats now building are completed, but ways will be added to some merchantman-building yards, and some new plants will have to be built. The Commission, all told, has placed contracts for 174 ocean-going ships, most of them under construction subsidies. Forty-seven are in service. The balance are 95 per cent completed and in case of emergency could be launched for Naval supply service.

There is something like a million tons of idle and de-commissioned shipping in the United States, much of it available to British purchase. Of the 111 World War laid-up ships owned by the Commission, Britain has taken 21, and other sales have reduced the ghost fleet to about 60. These and privately-owned idle ships sell for $300,000 to $500,000 apiece, and the British are likely to take many of them before they concentrate on building powered scows at a much higher figure. The Maritime Commission has no authority to sell any of its C-ships because the Government has a "mortgage" on them.

New Booklet Provides Information On Shows and Exhibits for 1941

NEW YORK—A new 34-page booklet containing information on American Shows and Exhibits for 1941 has just been published by Exhibitors Advisory Council, 120 Greenwich St., New York, N. Y. The booklet, which is sold at $5.00 per copy, is classified to cover 50 different industries and includes approximately 350 shows.

WILL MAKE JOHNSON RIFLE

PROVIDENCE, R. I.—The Universal Winding Co., Cranston, will begin manufacturing the Johnson automatic rifle in a few weeks. Company officials have established a separate unit known as the Cranston Arms Co., which employs 300 persons. Machinery has already been ordered and it is expected that production will begin in a month or so. No information is available as to who will purchase the rifle, but it is indicated by an official of the State Industrial Commission that "huge orders have been received from a very friendly country".

Aluminum Company of America Reduces Price of Aluminum Ingot

PITTSBURGH — Aluminum Co. of America will reduce the price of aluminum one cent per pound on Nov. 18. This brings the price of Alcoa aluminum ingot to 17 cents a pound. The present reduction in price is a continuation of a policy begun three years ago by the company. At that time it was announced that price increases would be avoided wherever possible. Aluminum Co. of America is engaged in an extensive expansion program, its output of aluminum will be in excess of 700,000,000 pounds in 1942.

Farm Tool Manufacture Improves Without Aid of National Defense

CHICAGO—Recent Department of Agriculture estimates indicate a total farm income of about $9,000,000,000 for this year, approaching the recent (since 1929) peak year of 1937. Farm mechanization continues at a good pace because of continued shortage of farm labor and low prices of farm equipment made possible by manufacturing improvements. Based on percentage of farm income which is usually spent on mechanization indications are that about $460,000,000,000 worth of equipment will be sold in this country. The excellent export business enjoyed so far this year bids fair to give the best record ever held in that division. Estimates are that exports may run $87,000,000. The combined total of manufacture, however, will not be quite up to the $571,241,833 total of 1937.

Other favorable factors for the farm equipment manufacturers are that many of them derive considerable business and revenue from the industrial tractor sales. Most of the manufacturers are experiencing a boom in present sales of industrial tractors. Caterpillar Tractor notably is running at full blast in Peoria.

Machine Tool Dealers, After Annual Convention, Inspect Monarch Machine Tool Co.

Interested—*In looking over a new development (above) were John Herkenhoff, Minster Machine Co., Minster, Ohio; W. F. Sandman, Marshall & Huschart Machinery Co., Indianapolis; A. G. Bryant, president, Bryant Machinery & Engineering Co., Chicago; and George F. Turner, The Strong, Carlisle & Hammond Co., Detroit, Mich. Wendell E. Whipp, Monarch's president, saw to it that all plant facilities and operations could be examined by the visitors. Other members of the company guided the dealers in their tour*

Inspection Tour—*At the close of the annual convention of the Associated Machine Tool Dealers at Dayton recently the Monarch Machine Tool Co. was host to the members at a party which included an inspection tour of the company's plant at Sidney, Ohio. Above, Fred C. Dull, Monarch's vice president and secretary; P. A. Abe, Monarch's vice president in charge of manufacture; and John Cetrule, Triplex Machine Tool Co., New York, examine some new tools in the plant*

Talking It Over—*Three good friends at the party are pictured above. E. P. Essley, E. P. Essley Machinery Co., Chicago, and Dan Harrington, Wilson, Brown & Co., New York, talk it over (but not too seriously) with George J. Zimmerman, president Strong, Carlisle & Hammond, Cleveland*

Attentive—*To the proceedings were J. L. Cochran, C. H. Gosiger Machinery Co., Dayton; Chris Baldenhofer, president and general manager, Thompson Grinder Co., Springfield, Ohio; Hugh Robinson, Monarch Machine Tool Co., Indianapolis; and Earl M. Wagner, Van Dyck Churchill Co., Philadelphia*

Machine Tool Exhibit Opened To the Public at Chicago Museum

CHICAGO—The machine tool area of the industrial exhibit at the Museum of Science and Industry in Jackson Park, Chicago, has been opened to the public. The exhibit is sponsored by the National Machine Tool Builders' Association. It was made possible by a contribution of Association funds and by contributions from a number of the members of needed equipment.

AID COMMERCIAL PLANES

WASHINGTON — Establishment of a priorities committee to coordinate commercial and military plane production does not indicate early restrictions on manufacture of commercial transports. Some weeks ago the Army began pushing the idea of an embargo on commercial plane production and the plan met opposition in the defense commission. The dispute was finally appealed to the President himself. FDR stood with the commission and it was decided that "a healthy air transport system is an important adjunct to national defense". The priorities committee was named to stand guard against Army attrition of commercial orders.

Full Canadian Armament Production Seen Late in 1941; Increase Government Plants

MONTREAL—Full production of armament in Canada won't be under way until some time in 1941, probably not until a year hence. Output will be at a rate of $1,500,000,000 annually in a country whose total production of manufactured goods of all kinds has been only a little more than $3,000,000,000 a year.

Most munitions manufacture thus far has been in a handful of privately-owned plants which started preparations before the war began. National Steel Car Corp., Canadian Car & Foundry and Dominion Foundries & Steel Corp. are among those companies. The bulk of the war program, however, is to be handled by government-owned plants, only a few of which already are in operation.

Production of 500-lb. aerial bombs will start in February in a huge plant being built "somewhere in Quebec." Normal output will be over 100,000 bombs per year. It will be the first time that aerial bombs of any kind, other than a few practice bombs, have been made in Canada. The long-range program will embrace all sizes and types of bombs. The weight will vary from 40 to 1,000 lbs. And the types from common high explosive bombs to aerial projectiles capable of piercing heavy armor plate. Canadian plants will be ready shortly to make 2-inch and 3-inch trench mortar bombs and .303 rifle grenades. Plans are being considered for production of anti-tank mines and depth charges.

3,000 Tanks Ordered

Some barrels for Bofors guns are being made in Canada, and a few have been delivered overseas. Shipments of motor vehicles for military purposes are going forth at a rate of 400 a day. An order for 3,000 tanks of new design will be in production early next year. Bren gun carriers have started coming off Canadian assembly lines.

Preparations are continuing for switch of Canadian airplane factories from British to U.S. models as part of the Canadian-U.S. joint defense program. British Anson planes, however, will still be made in this country.

Efforts of a new union to get a foothold at several Canadian shipyards has interfered with production schedules. Work at Canadian Vickers was disrupted for nearly a week. The government ordered a poll of Vickers workers resulting in a vote for continuance of shop committees instead of union representation by a majority of two to one. Union members were ordered to return to work and complied.

Though problems about power and raw materials appear to have been solved for the present, through imposition of government control, machine tool supply is still a worry. Canada must get a steady flow of machines from the United States to supplement domestic output.

Contractors May Apply to Treasury For Amortization Privileges

WASHINGTON—The red tape of defense is shaping up. The Defense Commission has worked out procedures by which defense contractors wishing to take advantage of the five-year amortization of defense facilities can prove to the Treasury that they are entitled to do so. Three certificates are involved. First, a "certificate of necessity" will certify, on the say-so of the commission and the secretary of war or navy, that the facilities to be amortized are necessary for the national defense. If the manufacturer is being reimbursed by the government "directly or indirectly" for the new facilities, he will have to get a "certificate of government protection" stating that the contract protects the interest of the government in the future use and disposition of the facilities. Defense commission lawyers are of opinion that inclusion in the price of goods made for the government of an item for cost of new plant would constitute indirect reimbursement. Finally, if there is no such reimbursement, the contractor will need a "certificate of non-reimbursement" to prove to the Treasury that he doesn't need a certificate of government protection. Instructions for getting these certificates can be obtained from War Department district procurement officers, the Assistant Secretary of War, or the Judge Advocate General of the Navy.

Canadian Labor Training Schools Provide Many Skilled Workmen

MONTREAL—The training schools, operated by the provincial governments and financed by the federal government, have already turned out 8,000 graduates from the summer courses. The entire number have been absorbed by war industries, particularly the aircraft plants. At present 1,900 young men are being trained at 11 schools, taking a four months' course of intensive training. Within the year it is expected that these schools will have supplied the air force alone with 5,000 to 6,000 airplane engine fitters, air frame mechanics, and similar workers. Between 25,000 and 30,000 are to be turned out over the next year.

FORD GETS HUGE DEFENSE ORDER

WASHINGTON—Ford Motor Co. came into the armament picture last week when the War Department awarded it a contract of $122,323,020 for airplane engines. It is the first defense contract awarded to the Ford organization. The contract calls for more than 4,000 Pratt & Whitney engines. As a letter of intention was sent to Ford last September by the War Department, the necessary plant expansion has almost been completed. Production of engines should not be long delayed. Additional recent orders are: Wright Aeronautical, $11,436,042 for airplane engines; Colt's Patent Fire Arms Mfg. Co., $8,074,406 for infantry weapons.

Auto Output for Last Quarter May Show a 25 Per Cent Gain

DETROIT—Production and employment in the automobile industry appear headed toward an even greater degree of stabilization during the fall and winter months than was the case a year ago. Plant managers were particularly proud of the relatively stable employment achieved during the 1940-model year.

October production soared to a new record of over 500,000 cars and trucks, and retail sales are likewise climbing to new heights. Manufacturers are confident that assemblies need be cut back only a very few per cent in November and December in order to prevent over-stocking dealers during the winter months. Chevrolet, for example, will continue its 5,000 per day schedule indefinitely because demand is out-running production capacity. Even if that assembly rate is continued into the winter months, it appears now that dealers will not be overloaded when the spring sales bulge occurs. Incidentally, Chevrolet displayed its 200,000th 1941-model on Nov. 7.

Scattered sales reports for the month of October indicate the strength of the market. In October, Pontiac enjoyed the biggest month in its history, selling 27,217 cars, or 61.9 per cent ahead of a year ago. During the balance of the year, factory production will be maintained 60 per cent ahead of 1939. Two six-day weeks have been worked so far. The October production schedule was 30,000 cars, whereas November output is pegged at 28,600 and December at 27,500. Oldsmobile also set a new sales record for the month, showing a gain of 38 per cent over last year. Domestic shipments of Plymouth passenger and commercial cars during October set a new record at 63,000 units.

INSIDE DETROIT

Forthcoming bomber procurement program may be handled exclusively by the automotive industry. From 12,000 to 32,000 planes are involved. "Committee for Air Defense" has been organized

BY RUPERT LE GRAND, DETROIT EDITOR

DETROIT—Evidence exists that the projected bomber-procurement programs of the United States and British governments will be completely fabricated and assembled in the midwest, instead of the previously announced plan whereby the auto industry would make the parts for final assembly at West and East Coast plane plants.

There are several reasons for this declaration: (1) Washington sources report that the government has under consideration the erection of as many as fifteen plants, to be privately managed, for production of major sub-assemblies and for final assembly purposes, (2) Detroit executives close to the National Defense Commission say that there is talk of putting up two huge final-assembly plants somewhere convenient to the automobile industry, (3) Mr. Knudsen has stated that plane plants should be frozen at present or contracted dimensions to expedite production of orders now in their hands, (4) the huge size of the projected programs assigned to the automotive industry (now reported anywhere from 12,000—32,000 ships) involves too many engineering, manufacturing, inspection and possibly insuperable shipping problems for proper coordination between auto plants and far-distant aviation assembly plants, (5) the method of placing contracts with auto plants for bomber parts will undoubtedly be upon a basis foreign to the business methods of the aviation industry, (6) responsibility divided between two industries, each accustomed to its own production methods, can hardly be looked upon as the best method of getting results, and (7) the aviation industry is naturally jealous of intruders in a field which it nurtured through many lean years, while on the other hand the automobile industry is not one to take dictation when cutting corners for mass production. For these reasons, well-informed local sources expect Mr. Knudsen to place sole responsibility for the complete new bomber-procurement program upon the shoulders of those operating the auto, body, parts and related equipment industries.

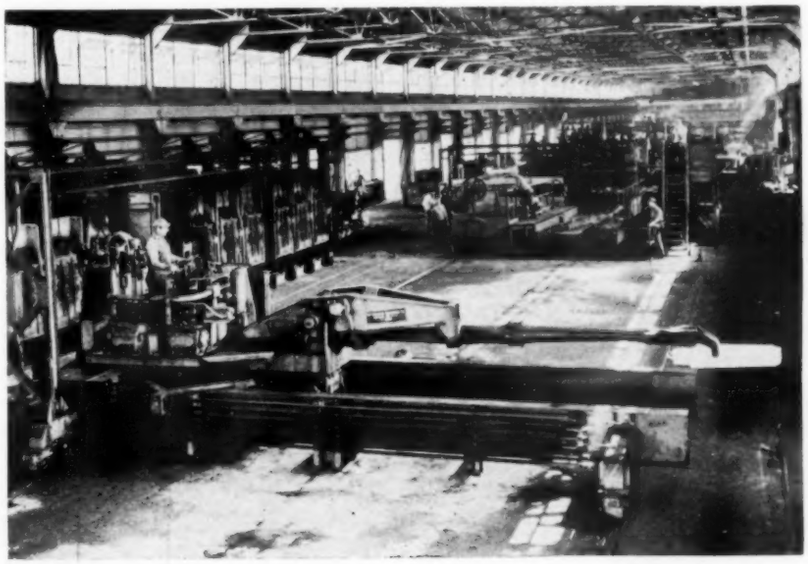
This line of reasoning appears correct, to judge from the rapidly expanding activities of the "Auto Committee for Air Defense". This is the new shortened name for the committee set up in Detroit on Oct. 25, at the joint meeting of the Automobile Manufacturers Association, the Automotive Parts & Equipment Manufacturers, Inc., and the Automotive Tool & Die Manufacturers Association. To the top committee appointed at that time—Alvan Macauley, Edsel Ford, K. T. Keller, C. E. Wilson, and C. C. Carlton—two new members have since been added. William Brown, president of Briggs, will represent the body plants, and Irving Babcock, president of Yellow Truck & Coach, will represent the truck manufacturers. Mr. Carlton is acting director of the committee.

Graham-Paige Building Leased

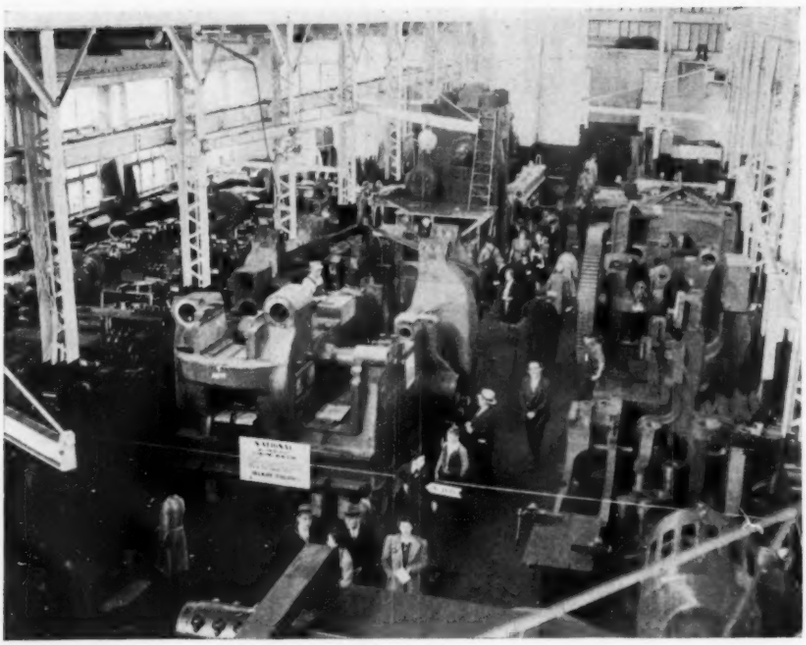
One of the committee's first acts was to lease the Graham-Paige administration building and part of the plant itself. This space will serve several purposes: (1) to house a large staff to be maintained by the committee, (2) to provide accommodations for possibly ten Air Corps officers, with Major James A. Doolittle expected to be liason officer between the Air Corps, the Auto Committee and the National Defense Commission, (3) representatives of the National Defense Commission and the British government may eventually be located there, (4) a complete display of bomber parts is now being set up in the former factory sales room of the Graham-Paige organization, and (5) complete bombers with all of their sub-assemblies and major parts will be arranged in the plant space so that prospective manufacturers of parts or sub-assemblies can study them in detail and then obtain the proper perspective of their function in the completed product.

HUGE PLANE PARTS CONTRACTS

DETROIT—Nobody can foretell just what the government contracts for aircraft parts will mean to the auto industry in dollars and cents until all cards are laid on the table. The 12,000 plane deal is said to be worth between two and three billions. Reporters asked Mr. Knudsen what the plane-parts program would mean to the industry, and he dismissed the query with "half a billion". It is likely that even he didn't know. By virtue of its size and complexity, the business will mean plenty of headaches. Just by way of comparison, the wholesale value of cars produced in the model year 1940 was $2,800,000,000.



The Only One—*Rustless Iron and Steel Corp., Baltimore, is the only manufacturing establishment devoted exclusively to the production of stainless steel. Recently the organization opened its new $2,500,000 plant addition. Above a specially designed charging machine withdraws hot ingots from the heating furnace and swings them to the mill table*



Open House—*The National Machinery Co., Tiffin, Ohio, recently invited the public in to see its plant. Manufacturing operations were continued as thousands of visitors passed by. The program was designed by the management to foster a better understanding of the close relationship between industry and the public. Above some of the visitors look over the machinery in one of the sections of the plant*

The Tucker Aircraft Corp., organized last May, occupies a building adjacent to that taken over by the Auto Committee for Air Defense. Tucker has just received a government order for $5,900,000 worth of gun-turret machinery and a $201,000 experimental order for development of an eight-cylinder air-cooled motor for training planes. Some Graham-Paige equipment is being used and more will be brought for arrangement in a straight-line production system. Another corner of the Graham-Paige plant is devoted to a hush-hush Navy contract.

Graham-Paige, of course, has given up auto manufacture. Surplus 1941 models are being disposed of by distributors. Its body plant at Wayne has been sold to Bendix. Graham is now seeking national defense contracts, sub-contracts or machine work suitable for its remaining facilities, or failing these to lease plant space.

The activities of the Auto Committee for Air Defense are still in the embryonic stage, despite groundwork already laid. It will be a month or more before a complete staff can be assembled. Meanwhile, industry concerns are being encouraged to look over the parts on exhibit with a view to fitting their production into the existing scheme or using idle facilities.

The main job now is to spread the work so as to: (1) achieve an early start on actual production, (2) coordinate the production of several hundred components so that none are lacking at the proper time, (3) set up facilities for sub-assembly of the larger structures like wings, center-wing sections, fuselage, tail surfaces and rudders. Undoubtedly, the last will require new structures, new machinery, and these enterprises will have to be placed so that their bulky products can be moved readily to final assembly.

The actual size of the government's bomber program is not so important to the auto industry right now as determining the means to make the "pieces." Once the setup is made, it is confident that mass-production methods will take care of the situation. So far it has been given to understand that 12,000 bombers are wanted exclusively for the United States Army. Two types have been selected—a Martin two-engine 12-ton job, which actually has been designed for mass production by sub-assemblies, and a Douglas bomber.

The labor problem may prove to be the crux of the matter. An average of 426,000 men were employed in the auto, body and parts plants during the 1940 model year. Working in the most efficient industry in the country, the productivity of these men was doubtless far higher than can be realized in the plane program. If contracts to the auto industry run into several billions, the difficulty of finding and training men may prove the major factor toward influencing curtailment of automobile production.

Failure of Lewis to Resign Would Muddle Labor Picture

NEW YORK—The result of the presidential election has served to muddy the labor waters and only a forthright reiteration of his intention to resign by John L. Lewis will help to clear them. Already, within the C.I.O., there is a vocal and energetic movement to "Draft Lewis". Left-wing, Communist dominated unions and United Mine Workers payrollers who followed Lewis into the Republican camp are taking up a cry of "indispensability" clearly designed to buttress their own fallen prestige.

The majority sentiment in C.I.O. ranks wants to wish the bushy-haired leader well and retire him to pasture. They are convinced that his ability to serve the interests of organized labor is now over and they refuse to sentimentalize by keeping him. The Communists, on the other hand, look at Lewis as their protector for they are sure that at his retirement the anti-red Philip Murray of the Steel Workers and Sidney Hillman of the Clothing Workers will be dominant influences. Then too, all other important C.I.O. officials, who have a chance of succeeding Lewis, are committed to reinstitute unity in the labor movement between the C.I.O. and A.F.L. and it is hard to conceive of an arranged peace that would make the Communist leaders welcome in a combined A.F.L.-C.I.O. Hence, with Lewis out and the road to peace open, the Communist-led unions face isolation.

Not Easy to Oust Lewis

Nevertheless, if Lewis remains silent it will not be an easy job to unseat him. At this time there is no leader of adequate stature in the C.I.O. to place anyone but Lewis's name in nomination at the convention which meets in Atlantic City November 18. It is a safe bet to presume that Hillman will not do it. If he takes the lead in an anti-Lewis move it will be interpreted as a personal gesture and thus will lose much of its effect. Murray is a miner and is apt to be silent in all discussions of a successor to his chief; it is likely that he will only accept the nomination for the C.I.O. presidency if John L. Lewis O.K.'s it and if he is assured that there will not be serious opposition. Other labor bigwigs of comparable prominence will support a move to replace Lewis, but will not lead such a movement.

But even if Lewis leaves the presidency of the C.I.O. he will remain in control of the powerful United Mine Workers Union. Nominations for the presidency of the U.M.W. are already closed and the only other man nominated, Philip Murray, has declined which leaves Lewis as the only candidate for that office. As head of the Miners, Lewis will still exert great influence in the councils of the C.I.O.

WATCHING WASHINGTON

Roosevelt election will have an adverse effect on metal-working industry. U. S. will train 30,000 at technical colleges for defense needs. Tin, copper, and pig iron prices and supplies watched

By BLAINE STUBBLEFIELD

WASHINGTON—The election results will not cause any immediate change in metal-working operations. But the accomplished fact of Mr. Roosevelt's election will make a difference in the near future, because he will accept his third term as a mandate to reassert basic international and domestic policies which he had modified for political purposes.

The President undoubtedly will start at once to expand airplane and arms aid to Britain, on a scale perhaps almost equal to a war effort. In the Pacific, it is apparent the Administration has pulled its punches at Japan, in the hope that the Nippons will desert the Axis. But if Japan makes overt passes at British and American interests, the President might move to send important aid to China also.

There are several means by which Roosevelt can build up any size of campaign-short-of-war for England. If he can convince the country that our most vital outpost is Europe, he can divert much or most of our own defense production to Britain. What is now going on secretly in a small way would be done openly in a big way.

He can permit the British to set up their own plants in this country, to use American materials and labor. He can sell to the British an enormous amount of shipping and, by securing an Act of Congress, could sell considerable quantities of outmoded rifles, field guns, and several hundred airplanes in the possession of the United States Army. With a little more patriotic fervor to back him up, he could call for, and probably secure, repeal of the Johnson law forbidding credit to war-debt delinquents. This does not seem to be an early possibility. The bottom of Britain's money barrel is still well covered.

On the domestic side, Roosevelt faces substantially the same Congress that has heckled and blocked him for the past two years—except that slight Republican losses make more difficult the formation of any Republican-conservative coalition. But where, since 1938, Congressmen have felt that they were riding the tide in opposing the President, they have now learned that he can't be licked. Having re-demonstrated political strength, Roosevelt and his advisors will sit more tightly in the saddle.

Even in the absence, however, of new aid to the lower third, the New Deal climate will make itself felt in the handling of defense production. The trend may now be in the direction of increasingly rigid controls, scheduling, priorities, profit limits. Meanwhile manufacturers will find themselves dealing with a less irritating but more powerful labor movement. The discrediting of Lewis and consequent accession of Hillman to effective if not titular leadership of the CIO is bound to result in unification of the two factions.

Colleges Train Defense Labor

Special courses, to be given by colleges and engineering schools at Government expense, will be offered to over 30,000 students with technical backgrounds to meet industrial needs in the defense program. The plan, after some months of study by the Office of Education, is announced by Paul V. McNutt, Administrator of the Federal Security Agency. Congress voted $9,000,000 for the purpose.

Both full time and part time students will be accepted. Instruction will be the same as that given for regular degrees, but will concentrate on defense needs, and courses will require from 2 to 8 months of study. Faculties will be augmented by teachers specially qualified by experience in industries to be served.

First courses to be offered will be design to forestall potential shortages of inspectors, materials, chemicals, explosives, instruments, power units, designers of machinery, equipment, tools and dies, aircraft power plants, instruments, engineers, metallurgists, and naval architects, etc.

Conflict in Priority Orders

Most pressing problem now facing administrators of the voluntary priorities system is elimination of conflicts between priority orders. While it is not true that all defense orders now have the same priority, all aircraft orders do have A-1 rating; since this represents the biggest chunk of machine tool orders, it poses a problem. In theory, there should be no difficulty; a preference number merely requires that sufficient priority be given to an order to permit completion by the contract date. There have been a few cases in which orders for goods urgently needed to open up bottlenecks have been given an as-quick-as-possible delivery date—equivalent to stepping up priority a notch.

But in the haste to get contracts out insufficient attention was given to avoiding conflicts of delivery date. A restudy of the outstanding contracts to straighten this out by changing dates is now under way. Some sub-division of preference classifications (A-1-A, A-1-B, etc.) may also be adopted.

There is a certain amount of industry pressure for some easy system by which a sub-contractor might obtain a higher priority than his prime contractor. Except in the case of machine tool subcontracts, however, this plea is not obtaining a sympathetic reception. It is still intended, however, to give a high priority to the orders for machine tools given by machine tool builders.

All of this thrashing out of difficulties, as well as drafting of a code of regulations, is now in the hands of the Army-Navy priorities committee. The Defense Commission's priority board will have the final say.

Pig Iron, Copper, Tin Watched

Three strategic metals came to the notice of Washington in the past fortnight. The price of pig iron became a matter of concern to the Defense Commission but a continuing supply at current levels seems probable. Defense consumption of copper is outrunning domestic production and importation from U.S.-owned South American mines is being considered by the Commission. There is a question whether the import levy of 4 cents a pound could be reduced by executive order, since it is not a tariff but is an excise tax.

NAVY BUYS SHOP EQUIPMENT

WASHINGTON—Navy expenditures for shop equipment, including machine tools, for Navy yards in the fiscal year 1941 will be as follows: at Portsmouth $1,650,000; Boston $1,675,000; New York $2,200,000; Philadelphia $1,200,000; Norfolk $1,500,000; Charleston $825,000; Mare Island $1,100,000; Puget Sound $1,100,000; Pearl Harbor $1,150,000; and Cavite $75,000. Much of this business has been placed.

United States Government Arsenal Commanders Who Have Been Promoted to Rank of Brigadier General

EDWARD M. SHINKLE

NORMAN F. RAMSEY

ROLLAND W. CASE

ALEXANDER G. GILLESPIE

Six Arsenal Commanders Promoted By U.S. as Army Expands Rapidly

WASHINGTON—Commanders of six government arsenals have been promoted from the rank of Colonel to that of Brigadier General. The arsenal commanders are: Edward M. Shinkle, Picatinny; Gilbert H. Steward, Springfield; Rolland W. Case, Watertown; Norman F. Ramsey, Rock Island; Alexander G. Gillespie, Watervliet; and Walter P. Boatwright, Frankford.

Brigadier General Shinkle joined the army after graduation from West Point in 1901. He was detailed in the Ordnance Department in 1906 and served at Sandy Hook Proving Grounds, N. J. He has served in the office of the Chief of Ordnance in Washington and commanded the Aberdeen Proving Ground, Md., during which time he was appointed Assistant Chief of Ordnance. He assumed command of Picatinny Arsenal in 1938 where he has served as Colonel until his present appointment.

Brigadier General Case has commanded the Raritan Arsenal, N. J., served as Ordnance Officer and Assistant Chief of Staff at Omaha, Neb. In 1937 he became commanding officer at Watertown Arsenal.

Brigadier General Gillespie served at the Aberdeen Proving Ground and Raritan Arsenal. He was appointed assistant, and later became commanding officer at Rock Island Arsenal. Later he was designated as Ordinance Manufacturing Arsenal Commander at Watervliet Arsenal.

Brigadier General Ramsey served as assistant Chief of Ordnance from 1912 to 1916. He was chief ordnance officer of the A.E.F. He had charge of manufacturing at Rock Island and in 1937 took command of the arsenal.

U. S. Government Contracts Awarded to Metal-Working Firms

Source	Agency	Commodity	Amount
Le Tourneau Co., Toccoa, Ga.	War	Artillery ammunition components	$4,569,290
Tennessee Coal Iron & R. R. Co., Birmingham, Ala.	War	" " "	5,823,600
Coslin Birmingham Mfg. Co., Inc., Birmingham, Ala.	War	" " "	1,740,000
Landis Machine Co., St., Louis, Mo.	War	" " "	769,100
S. A. Woods Machine Co., Boston, Mass.	War	" " "	846,000
Carter Carburetor Corp., St. Louis, Mo.	War	" " "	1,076,001
Budd Wheel Co., Detroit, Mich.	War	" " "	7,818,380
Pullman Car Mfg. Co., Chicago, Ill.	War	" " "	2,825,030
Murray Mfg. Corp., Brooklyn, N. Y.	War	" " "	840,000
Tube Turns, Inc., Louisville, Ky.	War	" " "	668,610
Pullman Car Mfg. Co., Butler, Pa.	War	" " "	1,590,000
Willys-Overland Motors, Inc., Toledo, Ohio.	War	" " "	8,820,040
Omaha Steel Works, Omaha, Neb.	War	" " "	2,955,750
Taylor-Wharton, Iron & Steel Co., Waton, Pa.	War	" " "	2,721,240
Bauer Brother Co., Springfield, Ohio	War	" " "	2,337,740
Mullins Mfg. Corp., Warren, Ohio	War	" " "	4,980,300
Revere Copper & Brass Co., Chicago, Ill.	War	" " "	2,160,000
Philco Corp., Philadelphia, Pa.	War	" " "	2,098,600
Federal Screw Works, Detroit, Mich.	War	" " "	1,249,500
Hoover Co., North Canton, Ohio	War	" " "	3,923,300
Bridgeport Brass Co., Bridgeport, Conn.	War	" " "	1,120,000
Scovill Mfg. Co., Waterbury, Conn.	War	" " "	2,821,504
A. & J. M. Anderson Mfg. Co., Boston, Mass.	War	" " "	1,570,800
Bethlehem Steel Co., Bethlehem, Pa.	War	" " "	785,000
Warren Webster & Co., Camden, N. J.	War	" " "	663,000
Wright Machine Co., Worcester, Mass.	War	" " "	1,091,400
Electric Household Utilities Corp., Hurley Machine Div., Chicago, Ill.	War	" " "	755,590
Chicago Roller Skate Co., Ware Brothers, Div., Chicago, Ill.	War	" " "	978,110
Electric Auto-Lite Co., Toledo, Ohio	War	" " "	748,000
Emerson Electric Mfg. Co., St. Louis, Mo.	War	" " "	822,232
Federal Screw Works, Detroit, Mich.	War	" " "	1,048,500
International Harvester Co., Chicago, Ill.	War	" " "	554,000
General Railway Signal Co., Rochester, N. Y.	War	" " "	1,400,000
Edward G. Budd Mfg. Co., Philadelphia, Pa.	War	" " "	574,793
American Brass Co., Waterbury, Conn.	War	Small Arms and ammunition	1,035,880
Revere Copper and Brass Inc., Baltimore, Md.	War	" " " "	661,660
Jack-Heintz Ltd., Palo Alto, Calif.	War	Starter assemblies	2,535,367
Buda Co., Washington, D. C.	Navy	Engines, for power boats.	673,062
Lukens Steel Co., Coatesville, Pa.	Navy	Steel plates	889,024
Worth Steel Co., Claymont, Del.	Navy	Steel plates	1,343,095
Carnegie-Illinois Steel Corp., Washington, D. C.	Navy	Steel	4,980,464
General Machinery Corp., Niles Tool Works Div., Hamilton, Ohio	Navy	Planers	571,200
Guiberson Diesel Engine Co., Harvey, Ill.	War	Engines	2,915,095
Lockheed Aircraft Corp., Burbank, Calif.	War	Airplanes	30,278,787
Parish Pressed Steel Co., Reading, Pa.	War	Carriages	1,674,591
American Locomotive Co., New York, N. Y.	War	Carriages	1,427,296
Consolidated Aircraft Corp., San Diego, Calif.	War	Airplanes	85,008,000
Bausch & Lomb Optical Co., Rochester, N. Y.	War	Height finders	1,797,465
Bendix Products Div., Bendix Aviation Corp., South Bend, Ind.	War	Aircraft armament	12,671,030
Yellow Truck & Coach Mfg. Co., Pontiac, Mich.	War	Trucks	717,988
Sperry Gyroscope Co., Brooklyn, N. Y.	War	Indicator and controller assemblies	9,961,240
Bendix Aviation Corp., Bendix, N. J.	War	Indicator and tube assemblies	3,186,315
Goodyear Tire & Rubber Co., Akron, Ohio.	War	Brake & wheel assemblies.	1,531,331
Lansdowne Stee. & Iron Co., Morton, Pa.	War	Ammunition components.	17,283,750

Promoted at G-E Philadelphia Works

ROBERT PAXTON

HAROLD E. STRANG

Metal Treaters' Prexy

CHARLES I. WESLEY

Oldsmobile Prod. Mgr.

R. E. GRIFFIN

NAMES in the NEWS

R. S. Clingan has been appointed Chicago District Manager handling Aristoloy Steels for Copperweld Steel Co., Warren, Ohio. For the past ten years Mr. Clingan has been connected with the Republic Steel Corp.

R. E. Griffin has been appointed to the position of production manager of Oldsmobile. Mr. Griffin, one of Oldsmobile's veteran employees, started his career in the service department in 1916. He was assistant service manager for several years and in 1921 took over the management of the distribution department which he held until his present appointment. T. R. Taffee, formerly assistant manager of that department, succeeds Mr. Griffin as manager.

Robert Paxton, formerly managing engineer of the Panel & Equipment Div., has been appointed assistant to the Works Manager in the Philadelphia Works of the General Electric Co. Harold E. Strang, formerly managing engineer of the Large Power Circuit Breaker Div., has been appointed engineer of the Philadelphia Works. L. S. Hobson was appointed managing engineer of the Power Circuit Breaker Div., and George M. Reed succeeds Mr. Paxton as managing engineer.

Ray R. Toepel has been named manager of the Brillion Iron Works, Inc., Brillion, Wis.

Harold B. Thomas, one of the founders of the Elastic Stop Nut Corp., Union, N. J., and vice-president in charge of sales, has resigned to enter consulting work in industrial product analysis and market research. Mr. Thomas remains active as a director and member of the executive committee of the corporation.

H. H. Timken, Jr., has been elected chairman of the Board of Timken Roller Bearing Co. to succeed his father, the late H. H. Timken, Sr. Mr. Timken will continue as vice-president and general manager of the Steel Div. John E. Fick, general superintendent of the steel division has also been elected to the Board. George W. Curtis has been appointed Milwaukee Div. manager of the company. Industrial and Automotive bearing sales as well as Alloy Steel sales activities of this division will be under his supervision.

Charles I. Wesley, president of the Wesley Steel Treating Co., Milwaukee, has been elected president of the Metal Treating Institute, Inc. of America, and N. M. Salkover, Cincinnati, has been elected vice-president. Arthur H. Nuesse, secretary of the Wesley Firm, was named National Secretary.

PLANT EXPANSION

Cutler-Hammer, Inc., Milwaukee, manufacturers of electrical equipment, has opened a new factory at San Francisco.

Curtiss-Wright Corp. will expand its St. Louis Aircraft plant six-fold. Scheduled to be completed late next spring the new plant will turn out $70,000,000 national defense orders recently received for military planes. The new building will have 1,200,000 sq. ft. of floor space and will cover 27 acres adjoining the present plant.

Bullard Co., Bridgeport, Conn., manufacturer of machine tools, has completed construction of a large foundry extension. The expansion will provide additional facilities to fill orders resulting from the National Defense Program.

Hoover Co., North Canton, Ohio, will construct a new $125,000 factory building in order to manufacture shell fuses for the United States Army Ordnance Department.

Hercules Powder Co., Radford, Va., will construct additional facilities for its plant. The expansion is valued at approximately $10,000,000 and brings the total cost of the plant to about $35,000,000. This will increase production by approximately 50 per cent.

Charles Bruning Co., Chicago, manufacturers of drafting engineering supplies and equipment, will build a new plant valued at $278,000. The plant is scheduled to be completed in about five months and will double the company's Chicago capacity.

Bastian-Blessing Co., Chicago, manufacturers of welding equipment, will construct a $500,000 plant for the manufacture of new equipment.

The American Rolling Mill Co., Middletown, Ohio, has begun a $5,000,000 plant improvement program for the purpose of effecting substantial operating economies and treating production. The program includes the construction of a cold reduction mill at the Armco plant in Middletown, at an estimated cost of $3,800,000.

Boeing Aircraft of Canada, Ltd., at Sea Island Airport, Vancouver, B. C., will erect a new plant with the aid of government funds. The expansion, which will cost at least $1,500,000, will cover approximately 28 acres of ground.

Joy Mfg. Co., Franklin, Pa., will add improvements costing $200,000 at two of its plants.

W. C. Lipe Inc., Syracuse, N. Y., is constructing an addition to its plant to provide for expansion of the machine tool division.

Rollway Bearing Co., Inc., Syracuse, N. Y., will erect an addition to its existing plant to provide the needed capacity for expanding business. The new building will be devoted to bearing assembly and shipping facilities.

Louis Allis Co., Milwaukee, is erecting a new factory building, 90 by 100 feet, at a cost of approximately $16,000.

Kempsmith Machine Co., Milwaukee, has opened a machine tool branch in Whitewater, Wis. The office is under the management of Robert W. Stevenson.

King Machine Co., Milwaukee, has purchased the Wisconsin Gray Iron Co. building and will also erect a $20,000 addition.

Colonial Broach Co., Detroit, has begun the construction of a new plant which will provide some 20,000 sq. ft. of manufacturing space. The addition is scheduled to be completed about January.

Cramp Shipbuilding Co., Philadelphia, has been authorized by the Navy Department to begin the expenditure of $10,000,000 to restore the shipyard for national defense work. Machines to cost $1,000,000 will be needed to retool the plant. The firm already has a $120,000,000 Navy order for six cruisers.

To further expand its aircraft engine production Wright Aeronautical Corp. has leased the plant of the National Dyeing and Printing Co., East Paterson, N. J. The 433,000 sq. ft. of new space will be used to build cams and gears for engines. The company now employs 13,000 and has a plant area in and near Paterson of 2,800,000 sq. ft.

BUSINESS ITEMS

Campbell Machinery Co., Detroit, has been reorganized under the ownership of C. L. Campbell.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., has purchased the Automatic Polishing and Buffing Machinery Division of the Continental Roll and Steel Foundry Co., East Chicago, Ind. The latter organization is now operated in Kalamazoo.

OBITUARIES

Charles L. Allen, 82, chairman of the board, Norton Co., Worcester, Mass., died at his home November 4. Mr. Allen, who served as general manager of the company for 48 years until his retirement from that post in 1933, was regarded as the dean of Worcester industrialists.

In 1881 Mr. Allen started with the Norton Co. as a bookkeeper. At this time the company was a struggling pottery shop employing 13 men. An experiment in making a grinding wheel led to the vast organization which now employs over 6,000 workers. The Norton Emery Wheel Co. was organized in 1885 and Mr. Allen was made its first general manager. In 1892 he became secretary and director of the company and in 1912 its treasurer. When the Norton Co. and the Norton Grinding Co. were merged in 1919, Mr. Allen was elected president and general manager of the Norton Co.

When Mr. Allen retired from the administrative leadership of the company in 1933, he became chairman of the board. With his finger still on the pulse of the business, and his years of experience at the disposal of the management, Mr. Allen remained a leading figure in the company. He was also interested in Norton subsidiaries, including Berh-Manning Corp., Troy, N. Y., and Norton Pike Co. of Littlefield, N. H.

Carl Arvid Edlund, 45-year-old manufacturer, died recently as the result of an accident. Mr. Edlund was president of the Edlund Machine Co.

Thomas F. Howarth, vice-president of the Simonds Saw & Steel Co., Fitchburg, Mass., died recently after a brief illness. He was 77 years old at the time of his death. Mr. Howarth joined the company as an office boy and worked himself up to an executive position. He served ten years with the company's San Francisco office.

John P. Danielson, 75, nationally-known tool manufacturer and president of the J. P. Danielson Co., Jamestown, N. Y., died recently after a brief illness. Mr. Danielson started his career as an industrialist in 1902 and was active up to the time of his illness.

Robert S. McManus, prominent figure in the nation's structural steel industry for many years, died suddenly in his home in Buffalo. He was 57 years old. Mr. McManus was president of the R. S. McManus Steel Structural Co. Inc., Buffalo, and he supervised the construction of numerous buildings, mills and factories throughout the East.

Industrialist Dies

CHARLES L. ALLEN

Herman W. Koerner, 79, president of the Universal Wire & Iron Co., Milwaukee, died recently. Mr. Koerner, with his son Elmer, organized the business in 1919.

Emil Vilter, 69, chairman of the board of the Vilter Manufacturing Co., Milwaukee, died Oct. 30. Mr. Vilter served as president of the company from 1919 until 1934 at which time he became chairman of the board.

Charles Fred Morley, machinery manufacturer, who was widely known as an authority on shell manufacture and often adviser on ordnance munitions to the War Department, died recently at the age of 56. At his death he was president of the Morley Machinery Corp., Rochester, N. Y. In 1920 Mr. Morley founded the present corporation which bears his name. Since then he has been frequently called to Washington for consultation on matters pertaining to shell manufacture. In 1933 he was on duty as consultant in the office of the Assistant Secretary of War and in 1936 at the Frankfort Arsenal.

MEETINGS

American Society of Mechanical Engineers. Annual convention. New York, N. Y., Dec. 2–5.

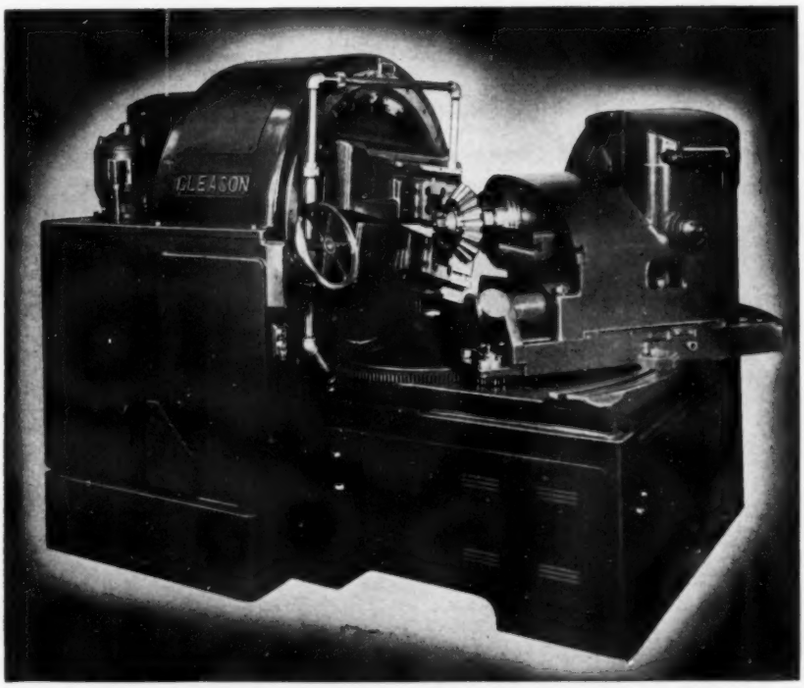
Motor & Equipment Manufacturers Association. Annual meeting. Blackstone Hotel, Chicago, Ill., Dec. 10.

National Exposition of Power and Mechanical Engineering. Grand Central Palace, New York, N. Y., Dec. 2–5.

Society of Automotive Engineers. Annual meeting, and engineering display. Book-Cadillac Hotel, Detroit, Mich., Jan. 6–10, 1941.

SHOP EQUIPMENT NEWS

Gleason Straight Bevel Gear Generator Cuts Teeth up to 50 Per Cent Faster



It is said to be possible to cut smoother, quieter running straight bevel gears up to 50 per cent faster with the No. 24 straight bevel gear generator introduced by the Gleason Works, Rochester, N. Y. This machine will handle gears up to 35½ in. in diameter and with pitches as coarse as 1½ D.P.

Generating principle is that of a relative rolling motion between the reciprocating tools and the gear blank. New type tool relieving mechanism and tool slides provide rigid tool support and permit higher stroke speeds than previously possible on machines of this size. Tool-slide ways are of cast iron, working against hardened steel. Fully inclosed cradle is mounted on anti-friction bearings in a rigid housing. Cradle reverse and index mechanisms are cushioned to give fast, smooth, quiet operation.

Heavy work head is secured to a large base which slides on a heavy one-piece frame. Feed for tooth depth and withdraw for indexing are applied to the sliding base through a cam and adjustable lever. Cam has a double track, one track for rough cutting and the other for finish cutting. Hyraulic in-and-out mechanism provides rapid movement of the work head.

Standard spindle is bored to 6 in. nominal diameter at the large end, with ¾ in. per ft. taper to facilitate chucking large-shank jobs and to permit faster cutting because of increased rigidity. A new type of universal stock dividing gage accommodates all pitches within the machine range, and can be used for either even or odd numbers of teeth.

Gearing is made with increased accuracy to insure more accurate tooth profiles. Adjustments of feed and speed rates, the index, the ratio of roll, and the amount of roll are all obtained by change gears for fast and easy set-up. Automatic lubrication is provided.

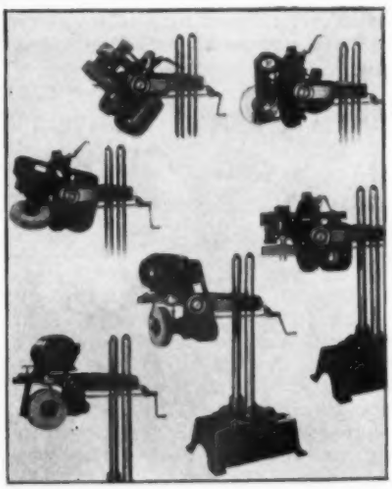
Specifications: Maximum cone distance, 17¾ in.; maximum pitch angle, 84 deg. 18 min.; minimum pitch angle, 5 deg. 42 min.; ratios, 1:1 to 10:1; maximum face width, 6 in.; index range, 10 to 200 teeth; floor space required, 74 x 105 in.

Murray-Way Buffing Head Pivots to Any Position

Murray-Way Corp., 253 Vinewood, Detroit, Mich., has developed a line of buffing heads which can be quickly adjusted to any wheel position for successive and production finishing, and which can be used in combination with dial type, indexing or continuous rotation dial machines, or with a continuous straight-line conveyor. Entire drive is mounted on a turntable which has a full 360 deg. of movement. Turntable and ring assembly, as a unit, is swiveled in the yoke member having, in the opposite plane, a full 360 deg. adjustment. Thus the wheel may be oriented in any position, there being absolutely no blind spots.

Besides the rotation of these two members, the entire head assembly may be moved vertically on the two columns which, in turn, have a swivel and lateral adjustment in the base. All these adjustments are made easily through cranks.

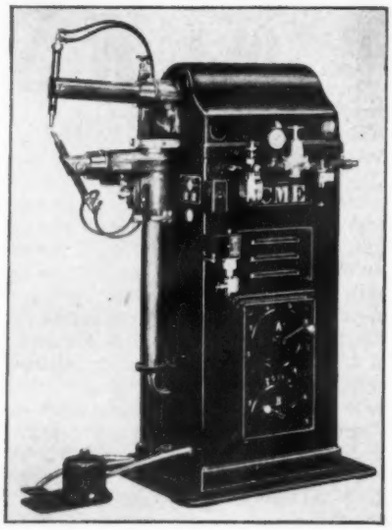
Buffing spindle is full floating, with adequate means for taking up wheel wear and maintaining predetermined work pressure. Dial table has a constant index time, but time of dwell



is varied over a wide range by electric controls. Timing device is graduated in seconds and minutes. All indexing mechanisms and fixture drives are completely enclosed and operate in an oil bath.

Acme "Hot Spot" Welder Has 48 Regulation Points

From 6 to 48 points of regulation are available on the Type 3 "Hot Spot" welder built by Acme Electric Welder Co., 5621 Pacific Blvd., Huntington Park, Calif. Available in capacities from 10 to 75 kva., these welders come completely equipped with automatic timers and magnetic contactors.



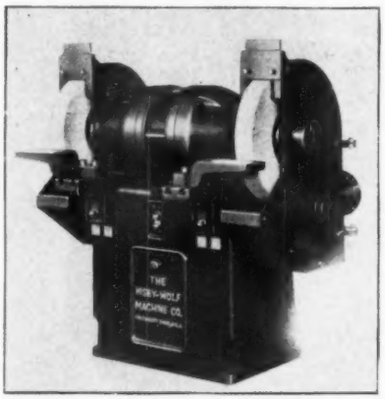
They are offered in various styles, actuated by a foot valve and limit switch, by a solenoid operated mushroom type floor switch, or by a specially designed two stage toe-operated floor switch. They are made for either single spot or automatic repeat operation.

Features include heavy fabricated steel base, transparent bowl, pulsating type lubricator, jewelled pressure gages, bronze pressure regulators, test switches and piston packed cylinders.

Hisey-Wolf Pedestal Grinder Furnished With New Guards

Hisey-Wolf Machine Co., Cincinnati, Ohio, has developed a 5–7½-hp. pedestal grinder which can be supplied with new guards designed in accordance with standards adopted by the American Foundrymen's Association. These new machines are built in 18- and 20-in. wheel sizes, with motor totally inclosed and ventilated through the pedestal.

It is claimed that it is impossible for work to jam between wheel and guard, as the guard extends far beyond the periphery of the wheel. Flange on outlet makes an easy connection to a dust collecting system.



Sensitive Production Tapper Made Available by Marburg

Marburg Bros., Inc., 90 West St., New York, N. Y., has made available a sensitive production tapper built by E. V. Haffling Co., Bridgeport, Conn. Developed to meet the needs of manufacturers of electric shav-

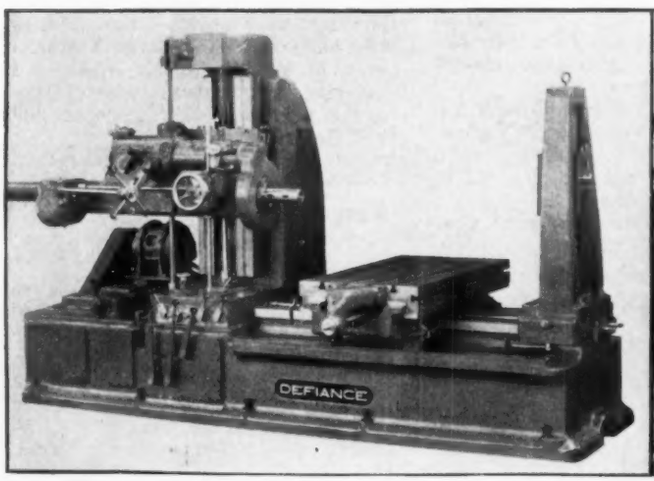
Defiance Boring, Drilling and Milling Machine Provides Large Number of Spindle Speeds

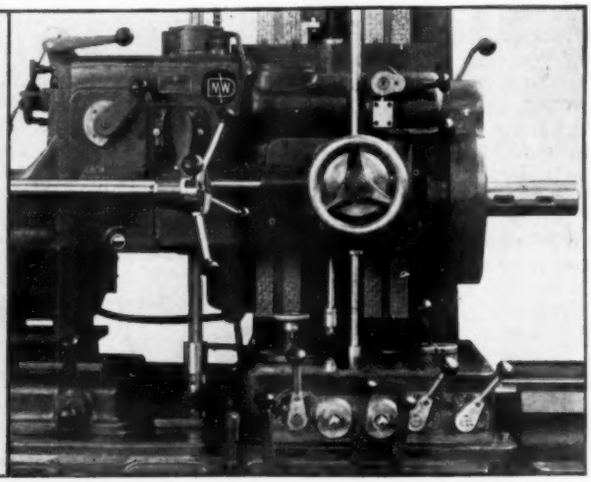
Defiance Machine Works, Inc., Defiance, Ohio, has developed the No. 25-A horizontal boring, drilling and milling machine to provide an exceptionally wide range of spindle speeds. The 3¾ in. diameter spindle normally has twenty speeds ranging from 12 to 1,000 r.p.m., and can be equipped with an additional low-speed arrangement giving twenty more speeds ranging from 4 to 420 r.p.m. This low-speed device does not reduce the high speeds of the spindle. Spindle sleeve rotates in Timken roller bearings. Shave finished helical gears are used in the head.

An outstanding feature of the machine is that the outboard supports under the table are integral with the base. These supports consist of hardened tracks and hardened steel rollers with compensation for wear. Base is extremely broad and is well ribbed for rigidity. Standard table is 30x60 in., with a full 60-in. cross travel.

Control is simplified, as the levers are reduced to a minimum and located within easy reach of the operator. Speed, feed and head units are force lubricated. Spindle, shafts and gears are made of heat-treated alloy steel. Oversize construction has been used throughout to provide utmost strength, rigidity, accuracy and freedom from vibration.

Machine shown is available in 5, 6, and 8 ft. bed lengths and with 30, 36, 42 and 50 in. head travel. A variety of tab'e sizes can be obtained. A dial indicator indexing device for the head and table movement is offered as an accessory. Verniers for these movements are also available.



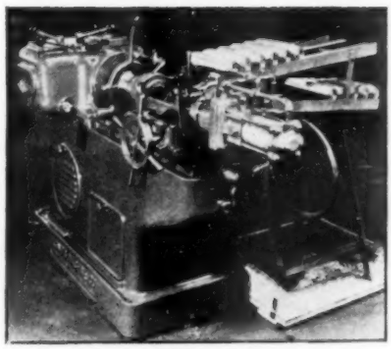


ers, clocks and other small precision mechanisms, this machine includes a super-sensitive friction clutch which can be set to such a degree that the tap will instantly stop whenever any predetermined tension between tap and job is reached.

In operation, the operator merely raises the table by hand or foot until the tap has started tapping. When the predetermined tension is reached the tap automatically stops cutting. Lowering the table engages the reverse clutch and withdraws the tap from the work. Machine is claimed to be of particular advantage when tapping plastics or other delicate parts which may break should the tap strike bottom. It is also said effectively to reduce tap breakage.

A simple adjustment changes the tapper into a power screw-driver. Machine comes complete with reversible motor, double clutch, tension spring, vertical spindle and chuck for tap. Standard equipment also includes feed table with hand and foot lever.

Shell Tapper Built by Landis Machine Handles Sizes Ranging From 75 to 155 mm.



Landis Machine Co., Waynesboro, Pa., has make available a machine designed especially for tapping the nose end of shells ranging from 75 to 155 mm. in diameter. This "Landmaco" No. 1½ R shell tapper possesses all features of other "Landmaco" threading machines, plus others to assure exceptionally accurate tapping on an unusually high production basis.

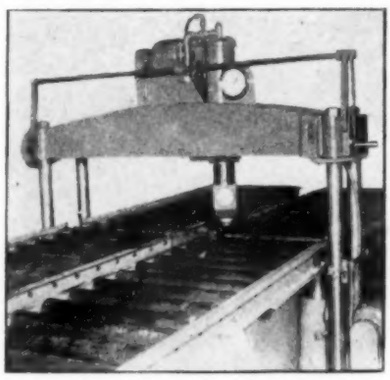
Special carriage or holding device with which the shell tapper is equipped comprises a work supporting cradle, hardened and ground bushing which supports the nose end of the work, and female center which supports the base end of the work. This female center is in alignment with the center of rotation of the machine spindle. Movement of the center is actuated by an air cylinder mounted at the rear of the carriage, and is controlled by a conveniently located lever. In operation the center pushes the work forward until the work sets firmly in the ground bushing supporting the nose end. This effects a locking action which holds the work rigidly in alignment for tapping. Female center and air cylinder are adjustable for shells of various lengths. In effecting set-up changes, for handling shells of different sizes, it is necessary merely to interchange the bushing which supports the nose end, the work supporting cradle, and the female center for those of the correct size.

Machine spindle is equipped with a special collapsible steel tap having all parts either hardened or heat-treated and precision ground. Tap design provides for internal ducts through which coolant is conveyed directly to the cutting edges of the chasers. The tripping collar also functions as a pilot to assure maintenance of unusually close tolerances for alignment of thread and body. Collar is ground to a running fit within a pilot bushing located at the front of the machine carriage adjacent to the bushing and supporting the shell nose. This pilot bushing operates in anti-friction bearings to minimize wear.

In operation the collapsing action of the tap is actuated by the tripping collar striking the end of the work. Thus danger of chasers striking the shoulder at the bottom of the work to cause breakage is eliminated. Furthermore, threads are held within very close tolerances for over-all length. Production is estimated to average 90 to 115 shells per hour, based on an operating efficiency of 100 per cent.

Brinell Hardness Tester Inspects Wide Plates

Detroit Testing Machine Co., 9390 Grinnell Ave., Detroit, Mich., has introduced a Brinell hardness tester for inspecting wide plates at any point without removal from the conveyor. This machine consists of a flat base (not shown) and cross-rail assembly supported by four posts. The test

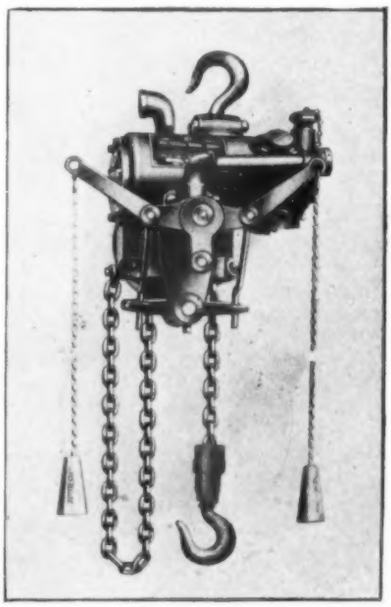


cylinder is mounted on a carriage sliding between the rails and is moved across the plate by a small motor operated by pushbuttons. Conveyor section, ordinarily furnished with the machine, runs between the posts. Test ram travel is sufficient to contact the work without any adjustment other than movement of the operating lever. Long stroke feature is available in standard units up to 24 in. stroke. Distance between posts is almost unlimited.

A heavy work-support rail runs between the conveyor rollers slightly below flush when idle. When a test is being made this rail is brought into contact with the bottom of the plate to take the load. In operation the plate passes over the rollers the desired distance and is held in that position by the work-support rail. Tests are then made across the width. Plate is then released, moved forward and testing is repeated.

Small "Air-Bloc" Hoist Lifts 700-Lb. Load

For lifting loads weighing up to 700 lb., Ingersoll-Rand Co., Phillipsburg, N. J., has introduced the "Air-Bloc" hoist. A flexible welded link chain hoist for use in machine shops, assembly lines, maintenance shops,



shipping and repair departments, this hoist is available in three sizes designed to handle loads of 300, 500 and 700 lb., respectively.

The unit weighs less than 75 lb., and can be easily moved from one job to another. An automatic up-and down-stop control prevents damage to the hoist from over-run of chain in either direction. Another safety feature prevents the load from dropping even if the air supply fails. Hoist is powered with a four cylin-

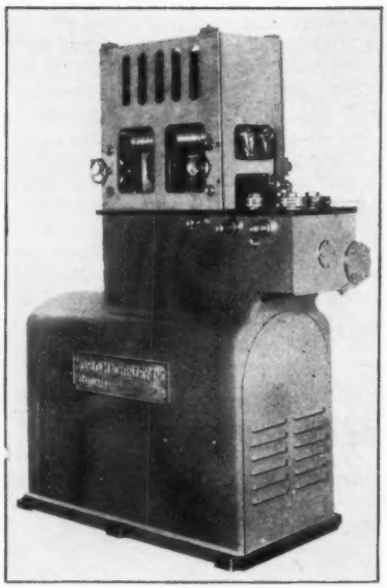
der radial air motor which, it is claimed, cannot be damaged by overloading. Sensitive throttle control permits easy and accurate spotting of the load.

Welding Rod Feeder Devised by Moslo

Moslo Machinery, Inc., 5005 Euclid Ave., Cleveland, Ohio, has developed a welding rod hopper feeding machine to pass straightened and cut welding rods into an extrusion press for application of coating material. A capacity of about 500 lb. of rods is provided.

Guide plates of feeding mechanism are arranged so that adjustment is obtained from a single hand screw, with positive adjustment assured. Thus it becomes possible to feed from the smallest to the largest diameter rods without fear of interrupted flow because of misalignment. Speed is controlled through an adjustable Reeves drive, permitting matching of feeding speed to that of any extrusion press.

Feeder rolls are placed in a vertical plane while support shafts are in a horizontal plane, improving accessibility. Pickup rolls have a single hand screw adjustment so that movement in or out is simultaneous. Feed pressure is maintained through a heavy-duty spring. Adjustment of



wire with guide tubes is always maintained, permitting full compensation for roller wear.

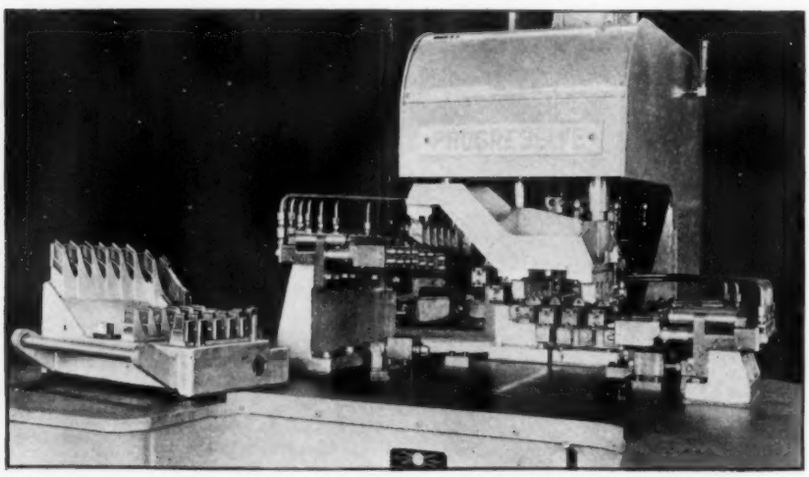
Drive mechanism is totally inclosed, running in oil on Timken roller bearings. Hardened alloy steel gears and large bearings are used. Feeder is supplied in three hopper sizes to take wire in 18, 24 or 36-in. lengths. Machine is capable of handling any length up to its maximum.

Rubber-Tired Fixtures Speed Up Spot Welding

Use of rubber-tired movable jig fixtures which form the lower electrodes during welding, as offered by Progressive Welder Co., 3001 E. Outer Drive, Detroit, Mich., enables some 1,000 stampings to be assembled with 4,000 spot welds into 100 complete radiator grille halves per hour in the plant of a leading automobile company. Other features which increase production include: multiple spot welding in series with 20 guns per station, each having two self-equalizing tips; equal pressure to all welding guns through use of a "Hydr-O-Matic" welding unit; complete automatic operation, including automatic locating of the movable jig; and elimination of hand clamping.

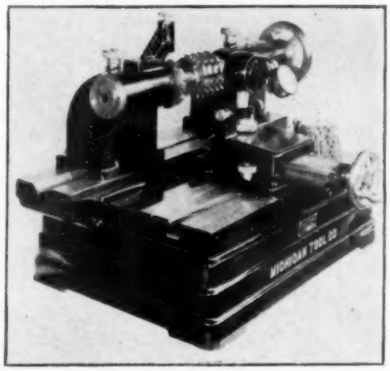
Welder has two dual stations. Two jigs mounted on rubber-tired wheels are used at each station. Both stations are manned by two men. Each man handles one of the movable jigs which he loads, shoves into machine for welding, and pulls out for unloading. Thus while one operator is loading his jig the second operator is welding.

In operation, a jig is loaded and is moved into welding position. Guides and locking pins on the table locate the fixture. When the wedges of the upper electrode descend they clamp the work held in the lower electrode. An air-operated clamp, the same form as the grille, presses the work in place and clamps the jig on the table. This compresses springs which support the wheels and permits pins at each end of the jig to engage locating holes. Two self-equalizing welding tips are mounted on each gun. Welding current passes from the transformer in the machine base through two tips of one gun, through the mobile jig and back through the two tips of a second gun to complete four spot welds at one time. Twenty spots in all are required for each grille half. When the welding cycle has been completed, the jig is automatically released.



Michigan Tool Offers Hob Checking Fixture

A fixture for routine checking of hobs after sharpening has been designed by Michigan Tool Co., 7171 E. McNichols Rd., Detroit, Mich. This fixture will check hobs for radial sharpening, spacing of flutes and runout of hubs. It can also be used for checking single form relieved cutters or form gashing cutters for sharpening and spacing.



Fixture is universal in character and has a maximum capacity of 12 in. diameter and 15 in. between centers. Dial indicator can be moved in both horizontal and vertical planes, while the head carrying the indicator can be moved parallel to the centers for checking at either end of a long hob. Vertical indicator movement is accomplished by a micrometer barrel having a graduated dial to permit exact setting.

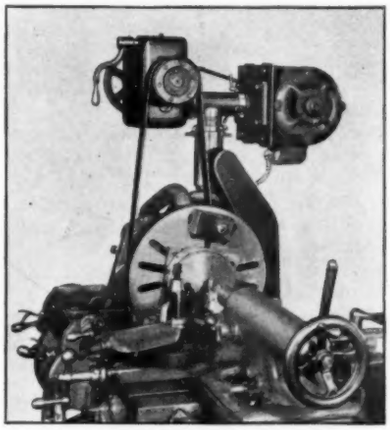
For checking the runout on diameters, a bracket is provided on the side of the slide. A standard indicator for checking runout may be mounted on this bracket. Inaccuracies

in readings due to play at the centers are avoided by mounting the index plate on the arbor, permitting the centers to be solid. The pawl which engages the index plate is mounted on the headstock of the fixture in a position to prevent it from loosening in its seat.

Over-all dimensions of the fixture are 38x25x20 in. Shipping weight is 450 lb. Furnished with each fixture are an index plate, a 1¼x6 in. arbor, and one indicator.

Berkeley Machine Tool Drive Uses 4-Speed Transmission

Either a 3- or 4-speed selective sliding gear transmission can be furnished on the motorized machine tool drives developed by Berkley Equip-



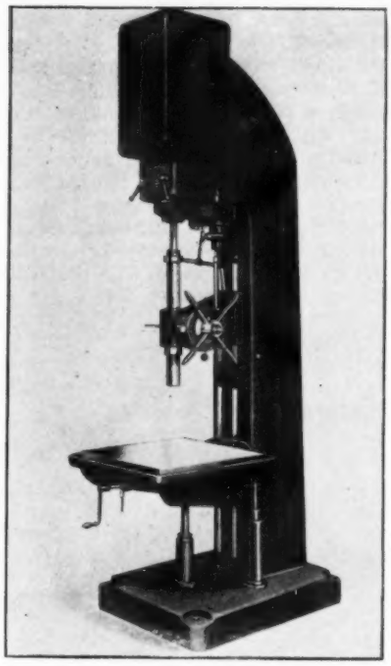
ment Co., Corry, Pa. These drives, mounted on specially designed custom-built welded steel brackets, can be easily applied to all types of tools.

Transmission gears are of large proportion, made of heat-treated alloy steel. Gears are moved in and out of mesh by yokes sliding on shafts at the top of the transmission and operated by a single lever. Highest speed is through direct drive. An interlock makes it impossible to mesh more than one pair of gears at a time. The unit operates in a steel housing so that the gears run in an oil bath. Simple means for belt adjustment is provided.

Motor-Spindle Drill Developed by Buffalo

Buffalo Forge Co., Buffalo, N. Y. has made available two sizes of a new type of motor-spindle drill. The No. 2, powered with a 2-hp. motor, can be furnished with either 8 or 13 in. overhang, while the No. 3, powered with a 3-hp. motor, is built with 13 in. overhang only. Pedestal models are available having from one to six spindles.

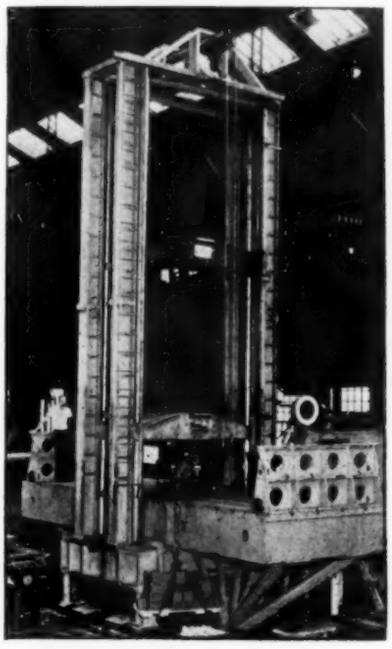
Machines can be furnished with or without back gears, with or without



power feed, and with or without motor reverse for tapping. A drum type pole changing switch is provided for starting, stopping and changing motor speeds. Overload protection is obtained by a thermal overload device mounted on the motor. Controls and wiring are inclosed.

Riehle Testing Machine Has 100-Ton Capacity

A 100-ton materials testing machine has been built by Riehle Testing Machine Div., American Machine & Metals, Inc., East Moline, Ill. Claimed to be among the world's most accur-

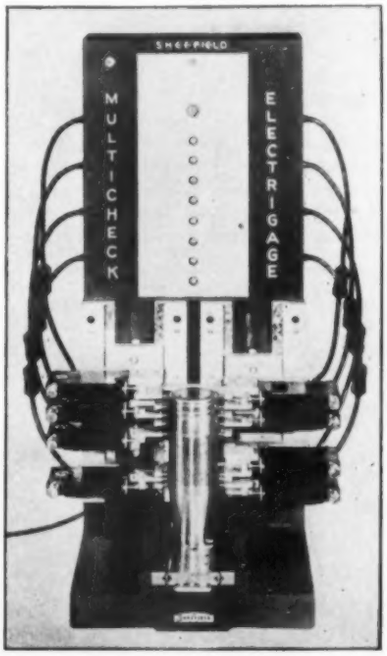


ate machines of this type, it is capable of indicating values with an error of 0.06 of 1 per cent while exerting test pressures of 700,000 lb. Machine measures 34 ft. in height, 21 ft. in width, and 24½ ft. from front to back. Transverse table is over 8 ft. wide.

Sheffield "Multicheck" Gage Permits Faster Inspection

The "Multicheck Electrigage" is a precision instrument for the simultaneous checking of several critical dimensions, developed by Sheffield Gage Corp., Dayton, Ohio. It is particularly adaptable for the inspection of timing fuse elements, shell bodies, cartridge cases and other munitions items.

Measurements of length, diameter and depth are flashed simultaneously on a control board by colored signal lights as the part being inspected is placed in gaging position. An individual gaging head is incorporated for each dimension to be checked, each head actuating a signal light.



When one of these signal lights shows amber in the gaging operation, the diameter is within tolerance. When the light shows red it indicates the diameter is undersize and when green, oversize.

In addition to the individual signal lights, this gage has a master signal light which integrates all measurements. When the master signal shows white, all dimensions are within tolerance. When it shows red, the individual signal lights are observed to determine which dimension is incorrect and whether it is plus or minus. Lenses are usually placed in a

straight line above or alongside each other. A plan of the work part indicates each dimension with its own light.

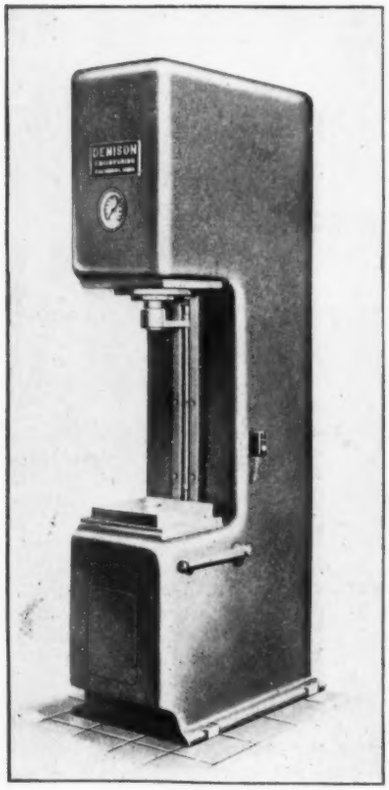
A patented reed mechanism is the heart of each "Electrigage" head. The mechanism employs no gears, knife edges or levers. There are no rubbing contacts, so it is not subject to frictional wear. It is so designed that it can be applied in innumerable combinations. Being a self-contained unit, if at any time the work upon which it is used changes, it can be dismounted and applied elsewhere.

It is claimed that one operator can check seven dimensions on a 75-mm. shell at the rate of 600 per hr. without eye strain. These instruments can be used on parts as large as desired, and are also being used on minute parts—such as a pinion less than ⅛ in. long and less than $\frac{1}{32}$ in. in diameter.

Denison Hydraulic Press Offered in Four Sizes

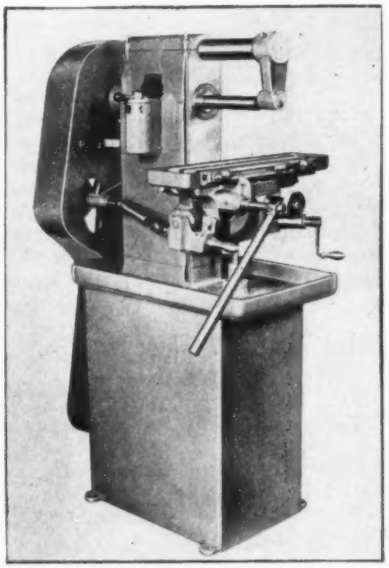
Denison Engineering Co., 236 N. Water St., Columbus, Ohio, has made available the Type DLAC2 general purpose hydraulic press in sizes of 5, 15, 25 and 50 tons capacity. Adaptable for assembling, straightening and general production pressing, this machine is completely self-contained and requires a minimum of floor space.

Control valve with its operating mechanisms, motor and pump are located in the center section. Ram and cylinder assembly is in the upper part of the C frame, and the oil reservoir is in the base. When the control lever is depressed the ram descends until it either contacts the work or reaches the limit of its downstroke. On contacting the work the press continues to exert tonnage until the controls are released. When the ram returns to the limit of the upstroke it stops, the pressure is released and the pump and motor run idle. Both up and down strokes and pressure are easily adjustable. Presses can be furnished for either manual or electrical operation. Frame is of electric welded construction with rounded corners and convenient toespace for operator. A constant volume vane type pump is used.



Improved Milling Machine Has Greater Speed Range

Miller & Crowningshield, Greenfield, Mass., has improved its hand and power feed milling machine by altering the V-belt drive to give a greater range of speed and to provide greater convenience in changing belts. Former base has also been replaced by one of all-steel construction.



A ½-hp. motor with a reversing switch is standard equipment, but a ¾- or 1-hp. motor is recommended for high-speed work. Motor and jackshaft each have a 3-step V pulley. Four interchangeable single V pulleys provide twelve speeds ranging from 180 to 3,200 r.p.m.

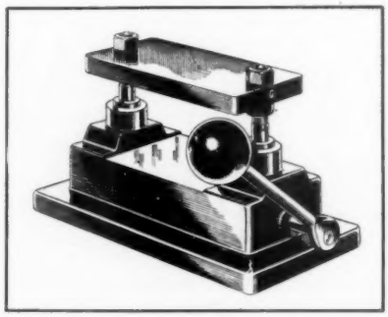
Lightweight Sound Meter Handles 24–120 Decibel Range

A portable sound-level meter, lighter and more compact than any previous instrument of its kind, has been developed by General Electric Co., Schenectady, N. Y. It weighs only 19 lb. but has a range of 24 to 120 decibels. It may be used conveniently for almost any kind of noise study, including airplane engines, motors, fans, generators, turbines, pumps, bearings, gears, cylinders and other machinery parts.

Essential parts of the device are a microphone, an amplifier and an indicating instrument. An arm extension protects the microphone from sound reflected from the case. The amplifier consists of five stages. Battery-operated tubes are mounted on a shock-proof base, thus reducing errors due to vibration. Complete instrument, including microphone, mounting arm, calibrating unit and batteries, is contained in a carrying case 12¾ in. long, 7¾ in. wide and 9¼ in. high.

Universal Drill Vise Features Simplicity

Mohr Line-Saw Co., 126 N. Union Ave., Chicago, Ill., is offering a universal drill vise said to be unusually simple in manipulation. Claimed to effect remarkable savings in time and in tooling cost, this device is adaptable for a wide variety of drilling operations. A slight pull on a ball-handled lever locks the work securely in place; work is released by moving the lever in the opposite direction. Screws, bolt, and nuts requiring tightening or loosening are eliminated.



Vise is also practical for use as a standard drilling jig. With different drill bushing plates and adaptors, it may be used for a wide variety of drilling operations. Tool is 9 in. long

In vertical Milling Machines also, rigidity originates in the column — the backbone of the machine—and determines the productive capacity of the machine more than any one other factor.

Note how carefully the column of a Milwaukee Vertical Milling Machine has been engineered for the proper distribution of metal — an inside horizontal wall divides it into a double box section, the cross mounting of the motor permits a solid rear wall, which, together with the solid front face, assures an unusually rigid structure.

KEARNEY & TRECKER CORPORATION • Milwaukee, Wis. U. S. A.

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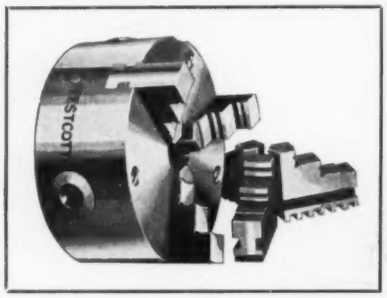
CORPORATION
Milwaukee
MILLING MACHINES

MILWAUKEE MILLING MACHINES

and 5 in. wide over base. It weighs 14½ lb. A 6½x3-in. bushing plate is furnished as standard equipment, and extra plates to meet an almost unlimited variety of requirements are available. The 40:1 compression ratio is maintained. Leader pins run in hardened and ground bushings.



Westcott Lathe Chucks For General Purpose Use

Westcott Chuck Co., 324 E. Walnut St., Oneida, N. Y., has introduced a line of light-weight "Oneida" universal lathe chucks for general purpose use. Mounted on the spindle by an adapter, these chucks are made with a semi-steel body and are equipped with two sets of jaws. Jaws, scrolls and pinions are heat-treated for longer life and greater accuracy. All parts are precision made with large bearing surfaces to provide firm grip and durability. Sizes available run from 4 to 12 in., with weights ranging from 9 to 82 lb.

Westinghouse Voltage Regulator Controls Smaller Generators

For automatic voltage control of small a.c. and d.c. generators, a quick-acting rheostat type regulator has been developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Known as the "Silverstat Junior," it is available in d.c. ratings up to 25 kw. and a.c. ratings up to 44 kva.

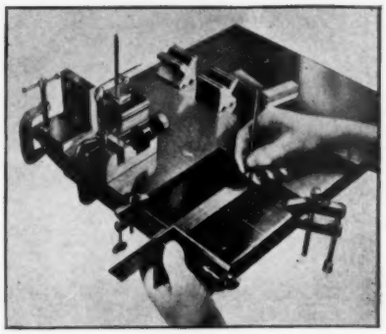
Inexpensive, simple, and dependable, this regulator performs continuously the same operation as obtained by hand manipulation of the field rheostat, keeping generator output voltage within 3 per cent of normal. Non-oxidizing silver buttons assure clean contacts and minimum wear. There are no parts requiring readjustment or replacement at frequent intervals.

Toledo Double Action Toggle Press Provides Extra Long Die Adjustment

An exceptionally long adjustment for high and low dies is provided on the No. 2-E-10-86 straight sided double action toggle drawing press developed by Toledo Machine & Tool Div. of E. W. Bliss Co., 1420 Hastings St., Toledo, Ohio. This press is of four piece steel tie-rod construction with shrunk-in tie rods. Castings are of high-alloy semi-steel with high strength and with increased surface hardness.

All gearing, eccentrics and other mechanisms are inclosed in the press crown. Covers are easily removable. A cascade filtered oil system is employed. Lower motion of the press is independently driven and electrically synchronized. Other features include triple gearing, V-belt drive, hydraulic friction clutch with disk brake, pushbutton control, hydraulically operated brake for stopping the flywheel after the power has been turned off, and a slide which is said to be completely counterbalanced by air cylinders.

Specifications: bed area, 62x86 in.; capacity of plunger slide, 650 tons; distance from bed to slide with stroke down and adjustment up, 75 in.

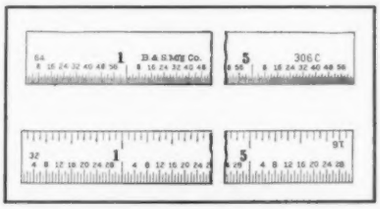


Low Cost Surface Plates Introduced by Delta

To meet the demands for reliable low-cost surface plates, Delta Mfg. Co., 620 E. Vienna Ave., Milwaukee, Wis. has developed 15 x 8 and 16 x 22 in. machine finished surface plates. These 3-in. plates provide a true surface to start with, a massive design and properly ribbed casting to insure the surface remaining true, ledges at the edges for clamping, and edges that are square with each other and with the face. These plates may be made into precision plates by scraping to a master plate or to one another.

B&S Flexible Steel Rule Has Three Scales

Brown & Sharpe Mfg. Co., Providence, R. I., has introduced a new 6-in. flexible steel rule for machinists. Identified as the No. 306C, this rule is graduated in 16ths and 32nds of an inch on one side, and in 64ths



of an inch on the other. Markings are such that the rule need not be turned end for end when changing from one scale to another. The rule is approximately ½ in. wide and 1/64 in. thick.

Precision Index Centers Offered by Hardinge Bros.

Hardinge Bros., Inc., Elmira, N. Y., has developed new index centers for its precision toolroom milling machine which incorporate sturdy construction, large collet capacity and features to speed up production in milling precision parts.

Compact box-like construction reduces over-all height and provides a sturdy base for spindle section. Spindle is mounted in super-precision preloaded ball bearings. Spindle sec-

Announced Sept. 3rd—Thousands already in Use!

Industry rapidly adopts—

NEW...CARBOLOY STANDARD TOOLS FOR "UNIVERSAL" SHOP USE ON 80% OF ALL TURNING, BORING, FACING JOBS!

Detroit, Sept. 3.—Mass production on a standardized line of Carboloy tools, designed to cover 80 per cent of all applications for cemented carbide tools, was announced by Carboloy Company, Inc., today.

The introduction of this simplified line of tools—comprising but five styles in three different grades—together with the economies resulting from mass production, has made it possible to price these complete tools well below comparable tools in the past, a typical new 'standard' tool, Style 4, now priced at only $1.85, comparing with tools previously costing $5.84 in lots of one. In quantities of 50 or more this typical tool now costs only $.90.

The program that has made this unprecedented step possible has been under development for the past three years. In the period from 1929 to 1937 prices of Carboloy cemented carbide

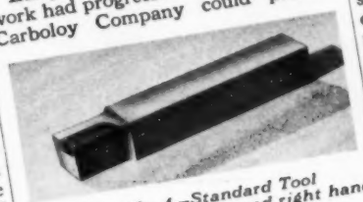
Style No. 1—Standard Tool
Available in 9 sizes

were progressively reduced four times as the result of economies resulting from increased consumption. About that time it became apparent that to widen the scope of useability of Carboloy tools required a complete revision of the principles under which such tools had been produced and sold up to then. What was needed was mass production of complete carbide tools on a scale never before attempted in this country.

Since 1937 extensive research work in the laboratory and in the field has been devoted to determining the fewest number of 'grades' of Carboloy and the simplest line of tools that would meet the vast majority of all carbide tool applications.

New $1,000,000 Plant Part of Program

Early in 1938 this development work had progressed to a point where Carboloy Company could proceed



Style No. 4—Standard Tool
Available in 9 sizes, left and right hand

with its next step—the expenditure of a million dollars on a new plant and equipment to expand and concentrate manufacturing activities. This plant, completed in the spring of 1939, was designed with a production capacity of ten times the amount of cemented carbide then consumed by industry, with provisions for expanding metal production to many times that amount.

Since that time, research and field experimental work has resulted in reducing the number of grades of Carboloy required for the vast majority of applications to only three —one new grade for steel cutting, and two for cast iron. Further, it was found that five styles of tools in each of these grades would cover 80 to 90 per cent of all turning, boring and facing applications.

The basic design of these tools is

Style No. 13—Standard Tool
Available in 5 sizes, left and right hand

such that several hundred variations can be rapidly ground in the tools by the user to meet special requirements. With the fast, simple grinding procedure developed during the past five years and now widely used by industry, such tool changes can be rapidly and economically accomplished. This rapid grinding procedure, plus the fact that the price of these new standard tools is comparable to that of many ordinary tools, brings to the field of Carboloy tool use a flexibility that permits broad 'universal' use of these tools within the average shop on short job-lot work as well as production runs.

The new standardized tools are carried in stock, ready for shipment, completely ground and ready for use. An extremely valuable feature is the incorporation of a ground-in chip breaker on all standard tools designed for the machining of steel, at no additional charge.

The new program, according to the announcement, is anticipated to produce a wider scale use of carbide tools, thereby reducing the cost of production of basic cemented carbides to [illegible] that in spite of higher [illegible]ost.

Carboloy Announces 6th Price R[illegible]

Since the year when Carboloy tools were first introduced it has been [illegible] of Carboloy Co[illegible]

For a number [illegible] have realized tha[illegible] reducing the p[illegible] lev[illegible]

- ✓ LOW PRICED! *(Check against any other cutting tools)*
- ✓ SIMPLIFIED ORDERING!
- ✓ SIMPLIFIED TOOL STOCKS!
- ✓ IMMEDIATE SHIPMENT!
- ✓ YOU GET THEM ALL GROUND READY FOR USE!

(Steel cutting tools furnished with ground-in chip breaker)

Example of chip breaker ground in steel cutting tools.

Have You the Facts?

WRITE FOR CATALOG GT-125

CARBOLOY COMPANY, INC.
11149 E. 8 MILE RD., DETROIT, MICH.

Chicago • Cleveland • Newark • Pittsburgh • Philadelphia • Worcester, Mass. • Los Angeles
Canadian Distributor: Canadian General Electric Company, Ltd., Toronto

CARBOLOY
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TANTALUM CARBIDES
TITANIUM CARBIDES
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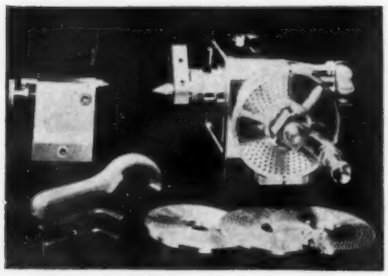
tion swings through an arc of 220 deg. and is graduated in degrees for settings from 10 deg. below horizontal to 20 deg. beyond vertical. A vernier in minutes is incorporated for fine settings. Precision, hardened spiral bevel gears and a nitrided spiral bevel pinion provide a 4:1 ratio between spindle and index plate crank. Index plate mounting is independent of the gearing with the spindle and crank, being engaged between the two by a clamp on the index plate outer periphery.

Anti-friction bearings are provided



for all gears and shafts. Spindle section has large swivel bearings and positive locks to secure angular settings. Index head may be mounted either crosswise or parallel with the machine table. It swings work having a 7 in. diameter. Index head and tailstock have a combined length of 14¾ in.

"Quicklag" Breaker Combines Thermal and Magnetic Action

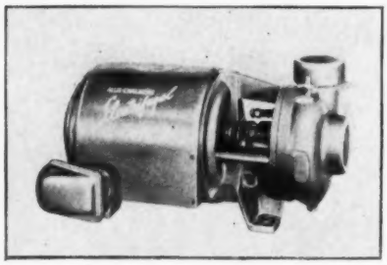
Designed primarily for protecting lighting and motor circuits, the "Quicklag" circuit breaker developed by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., combines for the first time in a single unit a cooperative magnetic and a thermal trip. It is available in ratings of 15 to 35 amp., single pole only, 250 volts a.c. and 125 volts d.c.

Combination of bi-metal thermal and magnetic trip action gives the device the advantage of instantaneous trip on short circuits combined with time delay for momentary overload. Breaker size is smaller per watts capacity than that of any similar unit before it. There are no live parts exposed to accidental contact. Calibration is permanent and is sealed against tampering. Operating mechanism gives a quick make and

break, and arcs resulting from heavy current interruptions are quickly snuffed out by the "De-Ion" grid assembly. To facilitate connections, solderless terminals are used. Operation is indicated by the handle position. Current ratings are marked on the operating handle, which is trip-free.

"Electrifugal" Pump Made Available by Allis-Chalmers

The "Electrifugal" pump offered by Allis-Chalmers Mfg. Co., Milwaukee, Wis., is an all-in-one centrifugal pump especially designed as a complete unit on one shaft and in one housing. Instead of using standard motors having special end housings and shaft extensions, this pump has a special motor with a one-piece



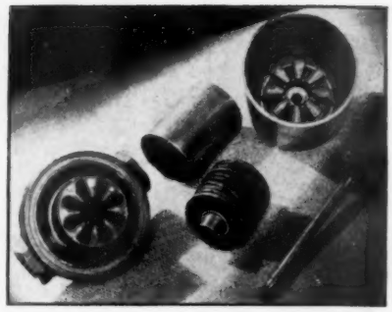
cast-iron motor yoke and pump bracket. Feet are cast integral with the housing and bracket, and extend under the entire unit instead of under the motor only.

Special motor design, with copper-bearing steel cover, meets N.E.M.A. specifications for splash-proof motors. Totally enclosed, fan-cooled motors and explosion-proof motors are also available in the "Electrifugal" type. In splash-proof construction the pump is available in sizes from 1 to 10 hp. at 3,500 r.p.m., and from ¾ to 7½ hp. at 1,750 r.p.m. for heads up to 160 ft.

For normal service the pump is built with cast-iron casing, bronze fitted. It can, however, be made of all iron, all bronze, all stainless steel, or other special metals to suit any application. In the chemical industry the sheet metal motor cover can be made of stainless steel to provide the longest possible complete unit life on any particular installation.

"FerroFilter" Oil Cleaner Uses Permanent Magnets

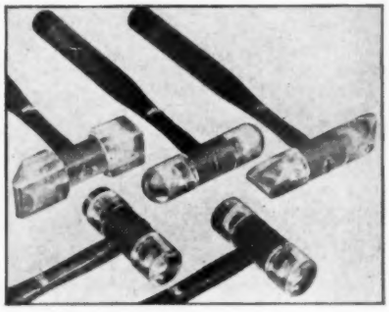
The "FerroFilter" oil cleaner developed by S. G. Frantz Co., 161 Grand St., New York, N. Y., for lubricating and hydraulic oil systems uses permanent magnets to extract minute iron particles that would pass through ordinary filters. The cleaner, which permits an unobstructed flow of lubricant, consists essentially of a case in which are mounted two "Nipermag" magnets. Between these magnets and within a bronze tube which directs



the oil flow are grids made of a high-permeability alloy. Iron particles flowing into the filter are held either on the magnets themselves or on the large magnetized grid area. Cleaning is accomplished by disassembling and washing in kerosene, an operation which is greatly facilitated by the fact that the grids become non-magnetic when removed.

Stanley Soft Face Hammers Made With Various Tips

An extensive line of soft face hammers has been developed by Stanley Tools, New Britain, Conn., for use on assembly jobs requiring a hammer

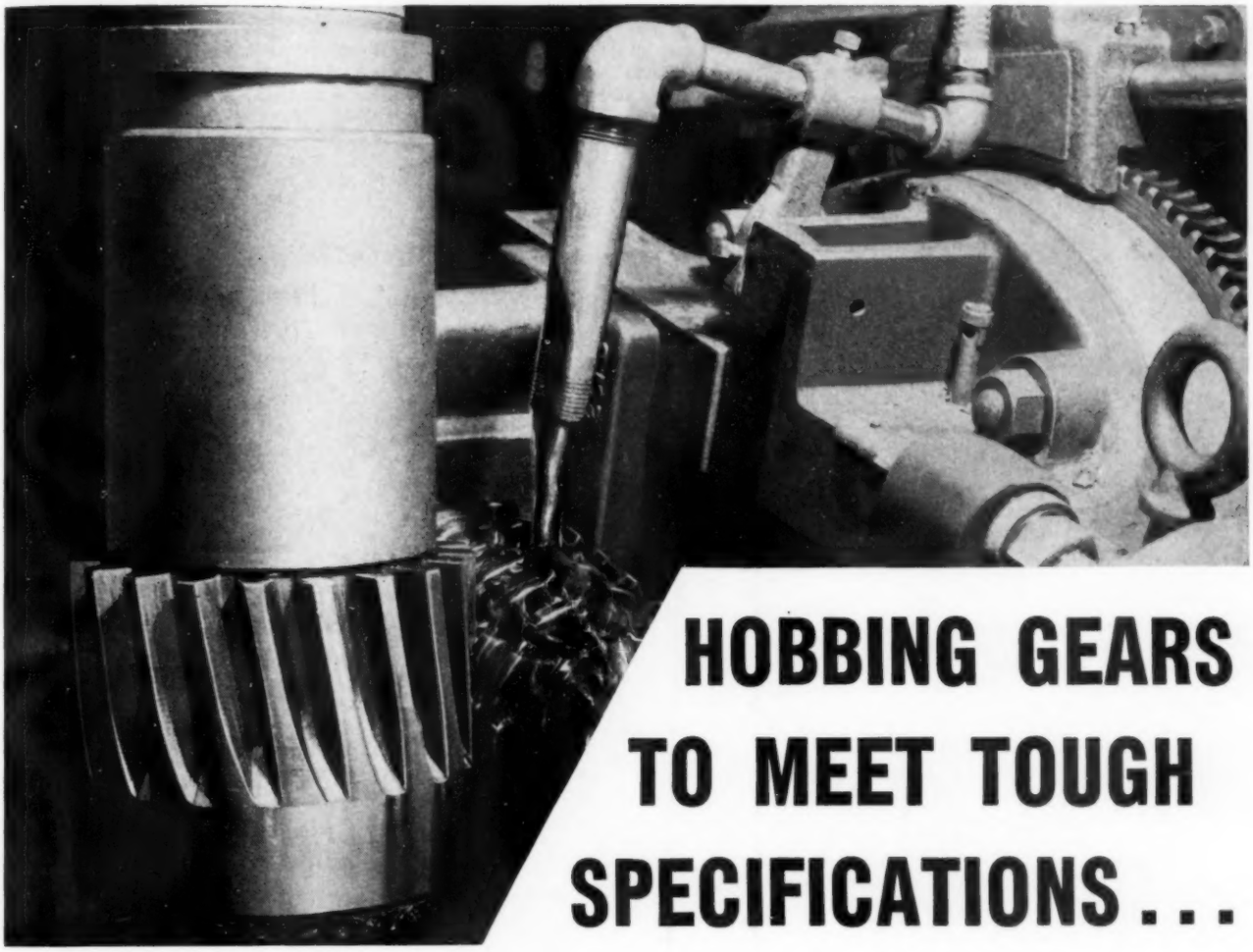


which will not mar finely finished surfaces or delicate machine parts. Tips are of "Stanloid," a tough, resilient, non-metallic substance. Hickory handles are securely wedged in a steel center body.

Various shaped tips—regular face, ball pein, cross pein, straight pein, offset pein, square tip, and regular face with brass insert—make these hammers suited for mechanics, machinists, sheet metal workers, motor builders, service men, and for workers in defense industries. All tips are renewable.

Lyon Die Handling Truck Maneuvers in Small Space

Lyon Iron Works, 550 Madison St., Greene, N. Y., has designed a die handling truck on which all four wheels can be steered for greater maneuverability in tight places. Turning of the wheels is controlled by a bar to which a removable handle is attached. This handle is arranged for hand-drawing or towing back of a power truck, and may be drawn



HOBBING GEARS TO MEET TOUGH SPECIFICATIONS . . .

HOBBING gears of extreme hardness (325—350 Brinell) as used in oil well pumping reducers—for particularly arduous duty—was the problem of a Chicago manufacturer. In cutting and maintaining this unusual hardness and maintaining high accuracy, Cities Service oils were used as the cutting lubricant.

No doubt you have one or two like problems in your shop. Why not find out what our lubrication engineers can do for you in your own shop with the right metal cutting lubricant? Just write us to have a lubrication engineer call.

Copies of our booklet on "Metal Cutting Lubrication" are available to users of metal cutting lubricants. Write for your copy today, before the supply is exhausted.

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Please send me booklet on Metal Cutting Lubrication ☐

Name.....*Title*.....

Business Address.....

Firm Name.....

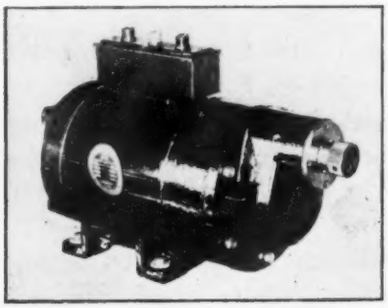
City.....*State*.....

from either end. The truck is arranged so that wheels on either end may be locked in position for towing at the opposite end. One wheel on each end is furnished with a brake.

Capacity of the truck is 8,000 lb. Platform is 24 in. wide, 60 in. long and 30 in. high. Wheelbase is 60 in.; over-all length is 72 in.; tread is 31 in.; and over-all width is 34 in. Trucks can be furnished with a hydraulic elevating table.

Walker-Turner Develops Two-Speed Geared Motor

Shock-proof geared motors built by Walker-Turner Co., Plainfield, N. J., have been made available with a double winding which, together with an interlocking switch, provides two speeds instantly changeable. This motor, the two speeds of which are



pushbutton controlled, is applicable to many types of equipment requiring instantaneous speed change.

Available in various speeds from 700 to 8,000 r.p.m. and in sizes from ¼ to 3 hp. for polyphase circuits only, this motor has been thoroughly tested in service as standard equipment on flexible shaft machines.

Close Temperature Control Achieved by A.T.C. Relay

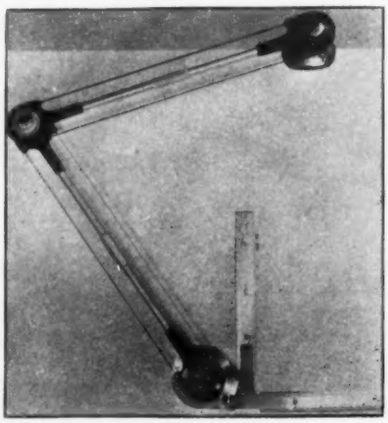
The A.T.C. balancer relay developed by Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa., is suitable for application on the proportioning type of fuel control systems for close maintenance of furnace temperature. It can be used on either batch or continuous furnaces, and besides maintaining a straight pyrometer chart line, it is claimed virtually to eliminate overshooting on coming up to heat. It is used with a pyrometer having a slide wire and high and low contacts with a no-contact neutral. Fuel regulator may be either a valve operator for oil or gas fired furnaces or an input controller for electric furnaces.

Among the features of the relay are

automatic load compensation, full anticipation when coming up to heat, adjustable throttling range and adjustable rate of reset. Case in which it is housed is suitable for either flush or surface mounting.

"Veeco" Drafting Machine Uses Combination Indexing

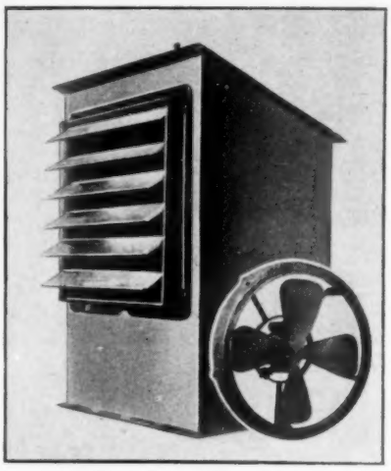
An outstanding feature of the "Veeco" drafting machine offered by V. & E. Engineering Co., 758 S. Fair Oaks, Pasadena, Calif., is its combination indexing. Manually controlled indexing for infrequent



changes in angular position is operated by a thumb-piece conveniently located in the handle. For automatic indexing, protractor arm can be set and automatically held at any predetermined angle. Elbow brake is readily adjusted by a single thumb screw to prevent sliding on inclined table. Head can be raised high to facilitate positioning the drawing paper. Zero reading can readily be set for a base line of any orientation. Head is supported by a large, centrally positioned plastic skid button. Engine divided circle is 4¾ in. in diameter.

Truflo Penthouse Fans Handle Gas, Fumes, Dust

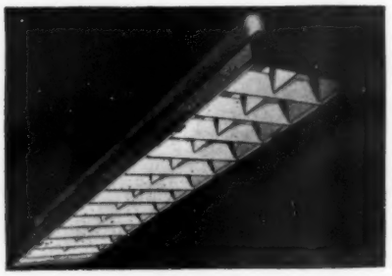
Truflo Fan Co., 557 Main St., Harmony, Pa., has developed an extensive line of penthouse fans for venting obnoxious gases, fumes and dusts. Penthouses are of sturdy steel construction, and are available in a complete range of sizes for housing standard Truflo wall fans of 12 to 48 in. diameter. Sheet steel walls and shutters are mounted on heavy angle iron frames. Shutters open and close automatically, and the



penthouses are designed to afford greatest possible protection against inclement weather conditions. Penthouse is placed directly over roof opening, and fan exhausts air through opening, or from several floors below by using a duct connected to bottom of fan housing.

Fluorescent Unit Louvers Help Kill Excess Glare

Better control of glare from fluorescent units is achieved by lamp-shielding louvers made available for the "Stream-liter" fluorescent fixtures made by Benjamin Electric Mfg. Co., Des Plaines, Ill. These louvers in-



You can cut-off *faster* with a MARVEL SAW

If you want high speed, quantity production of pieces or lengths cut from bar stock, you can get it best with a MARVEL Production Saw. These heavy-duty, all-ball-bearing sawing machines, equipped with an automatic bar push-up require no more attention than an automatic screw machine, yet cut-off more pieces per hour, floor-to-floor, than any other cutting-off method.

They set new standards for fast cutting-off with accuracy and low cost per piece, whether cutting off thin slices (as for gear blanks) or long lengths (like rifle barrels).

These high speed "automatic" saws come in two sizes: The MARVEL No. 6A, Capacity 6"x6", and the MARVEL No. 9A, Capacity 10"x10". With the other MARVEL Saws, they comprise the most complete line of sawing machines built—a line that provides exactly suited saws for every purpose.

MARVEL SAWS

ARMSTRONG-BLUM MFG. CO. "The Hack Saw People" 5743 Bloomingdale Ave., Chicago, U.S.A.

Eastern Sales Office: 199 Lafayette St. New York

crease the shielding angle to approximately 23 deg. in all directions. Such increased shielding hides the lamps when viewed from the side or end of the reflector in all normal angles of vision. Louvers are of steel, finished with a special high reflection factor white enamel. Parts are welded into a rigid assembly at each interlocking point, and the entire unit is welded to a rectangular frame rail which fits into the bead of the reflectors. It is held in position by two spring clamps on each side of the rail.

"Mu-Switch" Has Roller Actuator and Spring Leaf

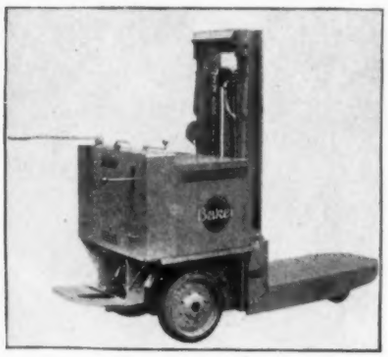
Comprising a phosphor bronze leaf spring riveted at one end to the switch cover and having at its free end a U-bracket which holds a ⅜ x ¼ in. plastic roller, this new style actuator adapts to high-speed cam operations the "Mu-Switch" made by Mu-Switch Corp., Canton, Mass. Self-lubricated roller permits

close bearing tolerances, with resulting accuracy of action, and gives quiet operation and freedom from wear. Type W actuator gives protection against overtravel, and is claimed to have long life under conditions of high-speed, high-temperature service.

Baker "Hy-Lift" Truck Operates in Narrow Aisle

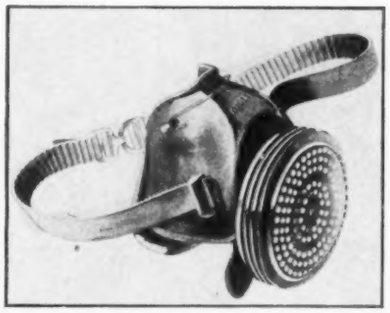
The type H-2 Series F "Hy-Lift" 4,000-lb. truck has been developed by Baker Industrial Truck Div. of Baker-Raulang Co., Cleveland, Ohio, especially for operation in narrow aisles and congested areas.

Lifting is accomplished by a hydraulic system incorporating a gear pump driven by its own motor and connected to the lifting cylinder through suitable control and release valves. Control valves are of the metering type, permitting absolute speed control at all times. Standard simple lift is 60 in. Standard telescoping lift is 119 in. All controls and hoists are grouped in a convenient control panel.



Willson "Bantam" Respirator Features Light Weight

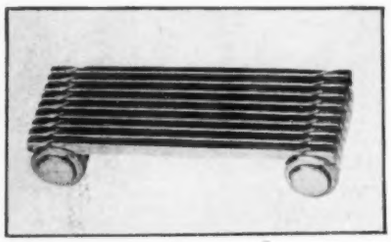
Claimed to be the lightest weight throw-away filter-type respirator yet to receive the U. S. Bureau of Mines



approval, the "Bantam" respirator offered by Willson Products, Inc., 251 Thorn St., Reading, Pa., is said to be so light and so easy to breathe through that it can be worn for long periods without causing any noticeable discomfort or slowing down of the worker. Rugged assembly includes an all-rubber face plate which cannot be crushed out of shape.

Wedge Wire Sections Now Made in U.S.A.

Wedge wire—wedge-shaped or undercut bars formed integral with solid heavy loops spaced at definite intervals—formerly available only from Europe, is being made in the United

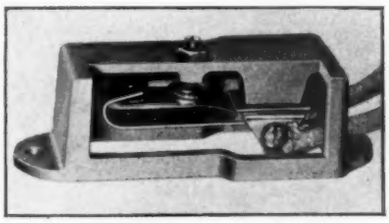


States by Wedge Wire Corp., 5200 Harvard Ave., Cleveland, Ohio. "Loop-bar" strands are fixed in grid form by cross rods riveted or bolted in place. Such construction assures dependable accuracy, strength and uniformity for high-capacity sieve and screen application. Standard apertures are 0.01, 0.02, 0.03 and 0.04 in. Screens can be made of practically any metal.

Strip Type Thermestat Mounts on Flat Surface

Claimed to be ideal for controlling temperatures of electrically heated flat surfaces, the "UL Strip" type thermostat is offered by George Ulanet Co., 89 Kinney St., Newark, N. J. A sturdily built element with large silver contacts and readily accessible adjustment screw is mounted in a cast aluminum housing which conceals the terminals.

Capable of handling 1,500 watts at



115 or 230 volts a.c., units are available with maximum operating temperatures of 300, 450 and 700 F. Either normally closed or normally open contacts can be provided. Contacts operate with a 5 deg. temperature differential. Device can be adapted to control air temperatures by perforating the housing. Dimensions of the unit are 4½ in. long, 1½ in. wide and 1¼ in. high.

G. E. "Wirometer" Helps In Solving Wiring Problems

A pocket-size wire calculator, called the "Wirometer", for use in computing wiring problems in accordance with the 1940 National Electrical Code, has been devised by General Electric Co., Bridgeport, Conn. Information which may be obtained quickly includes: conduit fill of all approved types of building wires, including wires of different sizes in one

conduit; corrections in current-carrying capacity for ambient temperatures over 30 deg. C., and voltage drop for eight distribution systems. The device is 8 in. long and 2⅜ in. wide, and is made up of two sliding celluloid covers and six interchangeable cardboard slides.

Fast Brass Plating Process Made Available by du Pont

A brass plating process two to four times as fast as present processes has been developed by the Electroplating Div. of E. I. du Pont de Nemours & Co., Wilmington, Del., to provide a plating method which will

yield smooth, bright deposits of controllable thicknesses at a more rapid rate of deposition. It also makes possible heavy brass deposits 0.001 in. or more in thickness, in a reasonable time.

Use is made of prepared high-speed brass salts to provide a simple, quick preparation of a new bath, which will plate immediately, eliminating the "breaking in" period necessary before satisfactory results are obtained. The process operates without polarization at high anode current densities, giving proper composition and color of plate and the purity necessary to maintain the efficient operation of the bath. Additional agents prevent pitting, improve lustre and prevent objectionable fumes.

The relatively low temperature of operation, 105-125 F., assures ease of control and economical processing. A uniform bright yellow color may be obtained over a wide range of current densities. Uniform color over recessed objects is possible. Characteristics of the deposit may be constantly maintained by definite chemical control.

Fluorescent Lighting Units Developed by Miller

Two industrial fluorescent lighting units have been developed by The Miller Co., Meriden, Conn. First is the "Masterlite" for general and localized industrial illumination. This unit is designed to give better general overhead illumination of production areas than has heretofore been available. It conforms to R.L.M. Standards specifications for a 48-in. twin 40-watt unit.

Second development is the "50 Footcandler", said to be the first 50 footcandle R.L.M. continuous fluorescent lighting unit for general illumination. It is available in either single or double length wiring channels for two or three 40-watt lamps.

Westinghouse Magnetic Starter Controls Squirrel Cage Motors

A line of magnetic starters for use with multi-speed squirrel cage motors of 220–660 volts, 1–100 hp., has been announced by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These units start the motor across the line at any speed. Different speeds are obtained by changing motor connections to change its number of poles.

Starters are available for the following types of multi-speed motors in 2, 3, or 4 speed types: constant horsepower, constant torque, variable torque, single winding and double winding. Features include pushbutton speed selection, accurate overload protection, low voltage protection, "De-Ion" arc quenchers, and front-of-board wiring with accessible terminals. Optional features include selective speed control, compelled

(advertisement)

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slow speed start, and automatic sequence acceleration and deceleration. All sizes are available in standard or dust-tight sheet steel enclosures.

Hammond Polishing Lathe Now Has Variable Speed

The "Rite-Speed" overhanging spindle polishing lathe (*AM*—Vol. 84, p. 776) made by Hammond Machinery Builders, Inc., 1618 Douglas Ave., Kalamazoo, Mich., has been improved by the addition of a variable speed transmission. With this device, available on the Model VRO machine, spindle speeds from 1,500 to 3,000 r.p.m. can be obtained by merely turning the handwheel at the front. An indicator at the side of the handwheel indicates speed at which the lathe is running.

NEW MATERIALS

Rust-Resistant Coating Developed by Scully

Scully Steel Products Co., 1319 Wabansia Ave., Chicago, Ill., has made available Type XP-320 graphite coating for rust prevention. This coating is spread on thinly and dries in from twenty to thirty minutes. It does not allow dust or dirt to adhere to the surface.

"Grainal" Alloying Agents Control Steel Composition

A group of alloys designed to assist the steelmaker in meeting more easily the close specification limits required by automotive, armament, machinery and other large industries is offered by Vanadium Corp. of America, 420 Lexington Ave., New York, N. Y. It is claimed that by the addition of only a few pounds of these "Grainal" ingredients ordinary carbon steels and low alloy steels attain hardness and other physical properties of more highly alloyed steels.

Observation indicates that the manner of functioning is entirely different from alloying agents in conventional alloy steels. It is thought that in addition to deoxidation for which other alloys are available, the new agents contribute to the fixation of nitrogen, the presence of which has been widely recognized as contributing to variable results in finished steels of otherwise identical physical and chemical properties.

"Carobronze" Bearing Alloy Has High Load Capacity

Manufactured by Revere Copper & Brass, Inc., and distributed by Wrought Bearing Metals Inc., 230 Park Ave., New York, N. Y., "Carobronze" hard drawn bearing alloy is claimed to provide higher strength, greater wear resistance and better machinability than ordinary cast bronzes. Further advantages are claimed to include better sliding properties, higher impact strength, and complete freedom from inclusions, porosity and blow holes.

The alloy contains 91.2 per cent electrolytic copper, 8.5 per cent pure tin, and 0.3 per cent phosphorous—the phosphorous content being closely controlled. It is supplied in three grades, each with physical properties best suited for the applications for which it is intended. Even in its toughest and hardest grade, the metal is said to retain a higher degree of ductility and shock resistance than other bearing materials. High loading capacity enables the designer to reduce considerably the length of bushings. Further metal savings are possible since the tubings are furnished to close tolerances. Tubing sizes are available from ¼ to 3½ in. in outside diameter, and round rods can be supplied in all sizes from wire up to bars about 3½ in. in diameter. Sheet and strip in a wide range of dimensions are also available.

TRADE PUBLICATIONS

ARC WELDING The Hobart Bros. Co., Troy, Ohio, is circulating a booklet, "Practical Lessons in Arc Welding," which gives general information and practical welding lessons. Price, 50 cents.

BEARINGS SKF Industries, Inc., Philadelphia, Pa. has just released a 36-page catalog, "SKF Spherical Roller Bearings," devoted to illustrations in mining, crushing, steel and allied fields. Information on bearing selection is also included.

GENERATING EQUIPMENT Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. is circulating a two-page folder which provides information regarding construction features of Simpac generating equipment.

HOBBING DATA — Barber-Colman Co., Rockford, Ill. is circulating a bulletin which contains hobbing data, a collection of case histories of field performance of Barber-Colman hobbing machines and hobs.

HOISTING EQUIPMENT Coffing Hoist Co., Danville, Ill., has published a general catalog, No. G-3, which provides illustrations, specifications and prices of a complete line of hoisting equipment.

LABORATORY EQUIPMENT Precision Scientific Co., Chicago, Ill. is circulating a 24-page bulletin, No. 315, which contains illustrations, detailed specifications, and perform-

ance data on a wide range of thermostatistically controlled laboratory equipment. Applications discussed are accelerated aging of materials, disintegration tests, dehydration to determine moisture content, and preheating of material such as plastics.

MOTORS An illustrated folder, "Small Motor Selector Guide," containing essential data needed to properly fit the right motor type to any job and covering the entire field of small motor applications has been issued by Department 7 N-20, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

PRECISION MACHINES Taylor Sales Co., Milwaukee, Wis. has just issued a series of bulletins which describe the operation and construction of dynamometers, drilling and balancing machines.

PUSH-PULLERS Owatonna Tool Co., Owatonna, Minn. has published a four-page bulletin, No. P-28, which provides specifications, prices and sizes of push-pullers.

SWITCHES Almo Mfg. Co., Newark, N. J., has issued a two-page folder which describes the advantages of Almo Mercury Switches.

WELDING Electric Controller & Mfg. Co., Cleveland, Ohio, has issued a four-page bulletin, No. 1211, which pictorially describes the operation and construction of weld timers and welder contactors.

NEW BOOKS

HANDBOOK OF ENGLISH IN ENGINEERING USAGE—*Second Edition. By A. C. Howell, Professor of English, University of North Carolina. 433 pages. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York, N. Y. $2.50.*

Engineering English is "boiled down" as much as possible, and frequently relies on illustrations, tables and curves to make clear its meaning. Nevertheless, ordinary principles of good English should be followed, whether the engineer is writing a letter or an engineering report. Poor writing almost always interferes with a man's advancement, whether he be an engineer or a member of any other profession. The fact that the writer is using terms familiar, for the most part, only to a given profession does not permit him to take liberties with good usage.

Both the beginner and the experienced engineer will find helpful suggestions in this second edition of the author's Handbook. Designed both for use as a handbook by the practicing engineer and as a text in college courses in English for engineering students, this edition has been arranged with an eye to clarity, accur-

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acy and utility. Some ten years have passed since the first edition came off the press. During this time it has been recommended for the "Engineer's Bookshelf" of the Engineer's Council for Professional Development, and has been used as a desk manual by many private corporations and government bureaus.

TO THE EDITOR

More About Those Tenths

Dear Sir:

In the article by Ed West, entitled "When Is a Tenth Not a Tenth?" the emphasis was placed on temperature differences as being the cause of inaccuracies.

There is a lot of scholastic bunk written about tenths. The human element figures quite as much as temperatures. To prove this point I conducted an experiment as follows:

I got a piece of high-grade cast steel and had it turned up in a lathe, leaving a collar in the center the width of the micrometer anvil. The reason for this was that everyone would measure the piece in the same place. I handed it to the grinder and told him to grind it as true and smooth as possible without regard to size. Then I selected the three best men in the shop and asked them to give me the size in tenths. They all used the same micrometers, but got different readings varying a tenth.

I have been a toolroom foreman for over twenty years. I have never turned out a job that I could absolutely guarantee was to a tenth at a given temperature, and furthermore I have never found it necessary to do so. I can give you more proof that this tenth business is largely bunk.

During the last war I was in charge of the tool department of a munitions plant. We had a set of master gages from which our working gages were checked every day. Our master gages in turn were periodically checked by a government inspector. One day he handed me a plug gage stating that it was a tenth oversize, with the request that I have it corrected. I took it in my office and laid it on the desk and forgot all about it until the inspector called for it as he was ready to leave. I took it back to him myself, just as it was, without comment. He checked it over again and said, "Thanks, it's o.k. now."

I admit that to work to a tenth is possible if one has the proper conditions, but to hold a man to a tenth on a commercial job is all nonsense.

Yours truly,
J. DAVIES
Oshawa, Ontario, Canada

Dear Sir:

Careful consideration of the article, "When Is a Tenth Not a Tenth?" by Ed West invites considerable criticism. Mr. West makes inappropriate statements as to the general conception of the shop man's tenth. It is my thought that he misstates his contentions and that in his inner self he will agree with my criticism.

He states: "In many cases we find inspectors gaging work after washing or heat-treating processes and before the pieces have come down to room temperature." The "cases" in which inspectors worthy of their titles do not recognize the fact that heat affects the size of closely machined parts are certainly not "many"; and I base my deduction on many years of experience in inspection work and on my contacts with hundreds of inspectors.

Parts which are machined to such close tolerances are almost invariably so machined after heat-treating by grinding, lapping, etc., and there would therefore be no point in measuring so closely immediately following the heat-treating operation, not to mention the impracticability of making close measurements while the parts are still hot, or while covered with heat-treat scale and compounds.

Regarding the effect of heat on size, arising from washing in hot solutions, let us see what may take place. Some metals used in machinery manufacture, at points which might necessitate machining to close tolerances, are steel, brass and aluminum. Let us assume that a careless inspector or machinist just washed such parts in hot solution, and by the time he returned to his workbench and began measuring, the parts are still fifteen degrees above room temperature. The coefficients of expansion of these metals are 0.00000636, 0.00000957 and 0.00001234 in. per in. per deg. F., respectively. Assuming the dimension to be an inch, measurements under such conditions would yield errors of 0.0000954, 0.000143 and 0.000185 in. While these errors may cause trouble in some cases, they are small when compared with ordinary shop measurements. Gaging to the fifth decimal part of an inch—and we must gage to the fifth to definitely ascertain the fourth—should be and usually is done in specially equipped inspection rooms by men who know how to measure correctly.

A factor which is not mentioned by Mr. West and which is more conducive to error, yet is less noticeable than the difference in temperature, is that of cleanliness of both the object being measured and the instrument. An imperceptible oil film, or a film resulting from the cleaning operation itself, will cause quite a perceptible error.

Substitution of hard contact surfaces of measuring instruments with softer ones to obviate exertion of undue pressure, which may deform the part, will not eliminate this trouble. The solution will be found in dispensing with instruments which do not provide means of checking the pressure applied, and in building up the required size, whenever possible, with Johansson blocks and transferring it to the part by means of a height-gage and indicator.

If and where inspectors or machin-

ists dealing with fine measurements are so uninformed in elementary principles as Mr. West portrays, criticism should really be directed at supervision or management for failing to recognize and correct incompetence, rather than at the particular individual who lacks knowledge and experience.

Very truly yours,
GEORGE BELBES

Uniformity—Of Charts or Products?

By J. A. DOYLE
W. S. Rockwell Company

Pyrometry practice in the metallurgical industry is generally not up to the high standard maintained by instrument manufacturers. Emphasis on temperature control frequently leads to a disregard of the influence of other factors affecting uniformity of the product—factors which are just as important as those related to means for indicating and controlling temperature.

Much of our prevalent industrial heating practice is the equivalent of producing uniform temperature charts and non-uniform products. Evidence of uniformity in the chart is frequently offset by proof of irregularity in the product. Thus the practical effect of much of our elaborate provision for temperature control is that we are doing the wrong thing more conveniently.

A significant illustration of the prevalent distorted viewpoint on the relation of pyrometer to product is afforded by a specification for heat-treating equipment recently issued from an outstanding source. The specification disposed of the fundamental requirements for operation of the equipment—in terms of heat-treated product—in less than two lines. Yet there were about four pages devoted to detailed specifications of the mechanical characteristics of the temperature control equipment. Other essential factors that affect uniformity of product were ignored in an effort to indicate preference for specific means of indicating temperature at the end of a thermocouple, which may or may not represent the actual temperature of the product itself.

The need for control of time and rate of heating and cooling, because of varying shapes of the individual pieces, is well illustrated in the case of a gear blank and the gear cut from it. The difference in section and exposed surface produces a difference in the rate of heating and cooling which should be controlled equally with the time factor. The rate of heating should be slower, and the time required may be less, with the cut gear than with the original blank because of the difference in absorbing surface—even though they are heated at the same time, in the same chamber, indicating a perfectly uniform temperature.

The long-established practice of heating and cooling structural steel shapes and railway rails—*individually*—is in marked contrast to mass methods of heating and cooling bars, shafts and other expensive alloy steel products. If it is right in one case, then it is wrong in the other. Yet we find outstanding technical authorities defending such an illogical condition on the ground that pyrometer charts indicate the temperature required by specifications; that the mythical "time for soaking" offsets any irregularity. The fact that individual pieces at the top and bottom of the mass may be exposed to different temperatures, for different times, and may react differently under the influence of the atmosphere, illustrates the difficulty of maintaining uniformity in the product under such conditions.

"Process specification" has been suggested as a means for achieving product uniformity. This is in no way intended to affect the metallurgical specifications, nor to indicate how the producer is to do his job. It permits him to write his own ticket for any desired standard of quality—whether good or poor—with any preferred composition of material or method of processing. It is proposed, as an amendment to the laboratory specifications, to effect better control of the individual heating and cooling operation to such a degree of uniform shop practice that will insure reasonably uniform products from day to day in the individual plant, or from different plants producing under the same specifications. It is primarily intended to indicate preferred methods of exposure or loading in heating and cooling, and the preferred rate of heating and cooling, time and exposure, which determines the actual temperature of the product, atmosphere and other essential factors.

Possibility for improvement is illustrated by outstanding accomplishments of the automotive industry in establishing higher standards of uniformity which are necessary for the proper function of its product. That industry has forced improvements in many other industries that otherwise would be likely to resist change, as many do today. Such improvement has been effected in production of ball and roller bearings, condenser tubes, steel sheets, wire, and a great many other products—in addition to an astounding development of new production equipment.

In the process of cooperating to determine why the product varies(when the pyrometer chart indicates it should be uniform) there will be developed a better understanding of the actual relation of uniform temperature charts to uniform products. Also a gradual realization of the fact that a lot of what we now think we know about uniformity really isn't so.

Abstracted from the American Institute of Physics Symposium.

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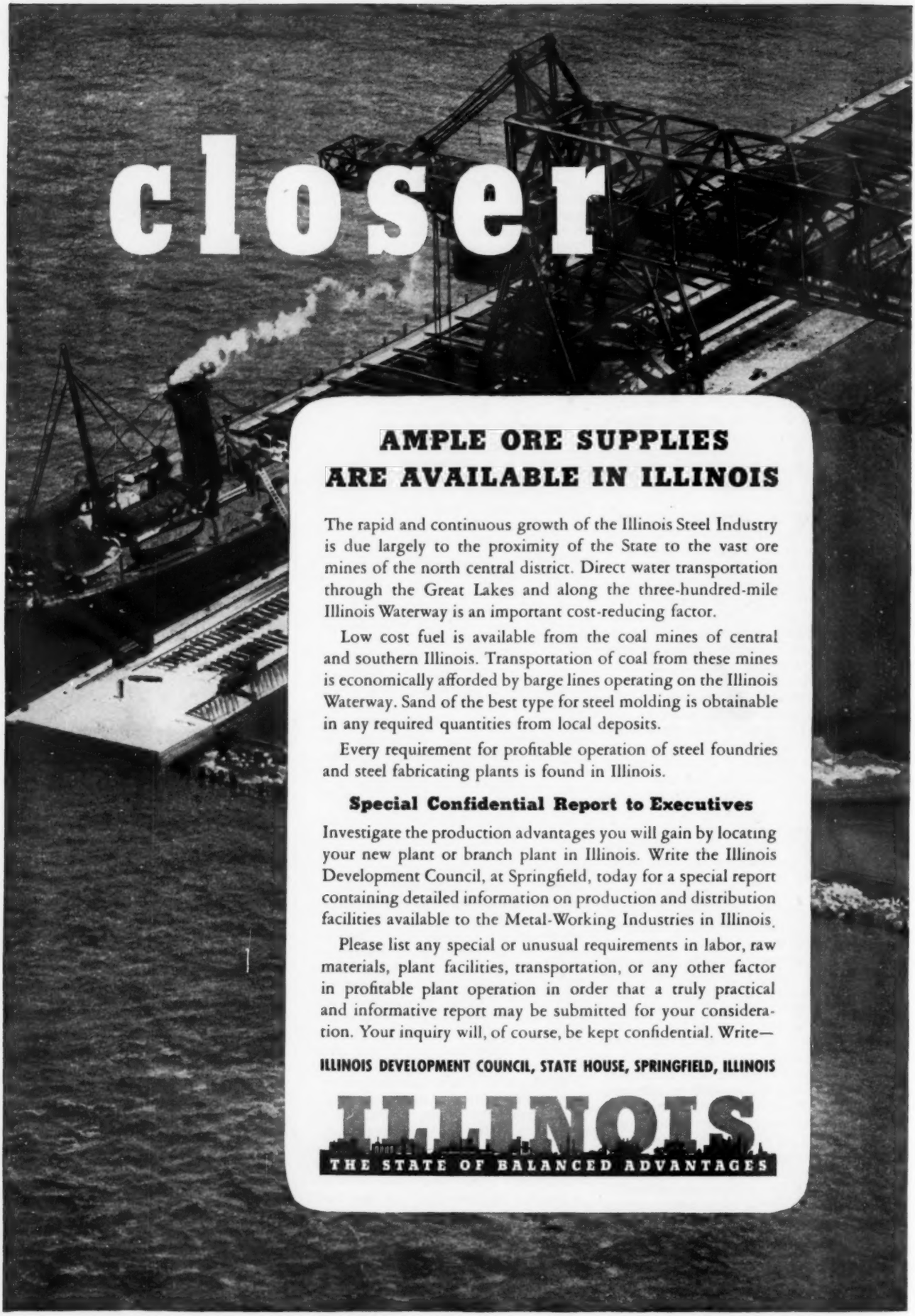

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ILLINOIS DEVELOPMENT COUNCIL, STATE HOUSE, SPRINGFIELD, ILLINOIS

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